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The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY OF NOTRE DAME.
NOTRE DAME, INDIANA.

VOLUME XIII.

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ADDITIONAL FORAMINIFERA FROM THE RIPLEY FORMATION IN ALABAMA.

JOHN R. SANDIDGE.

The large foraminiferal fauna from the Ripley formation in Alabama has been partially treated by the writer in short articles which appeared in the July and September issues of this journal, and in the September issue of the *Journal of Paleontology*. This additional contribution to the previously described species enlarges the number of published species and varieties to a total of 97. There are yet many forms too poorly preserved for determination, or known only from fragmentary specimens, as well as many probably undiscovered species, which remain to be described, and it is not likely that the fauna will be in any measure complete for many years.

Knowledge of the Ripley foraminiferal fauna is desirable because it provides a new approach to an understanding of the Upper Cretaceous in the southeast. This information is particularly applicable to the interpretation of conditions of sedimentation, the distribution of land and water in the Cretaceous, structural relationships, and the possibilities of oil accumulation in the region.

Work on the foraminifera from the Ripley formation in Alabama was begun in 1925, while the writer was a graduate student in the Geology Department of Johns Hopkins University. The early stages of the investigation were carried on under the direction of Professor E. W. Berry, whose interest and assistance were of great value, while inspiration and encouragement also were received from Profes-

sors E. B. Mathews and J. T. Singewald, Jr. Dr. J. A. Cushman contributed to the work by allowing the writer to study in his laboratory at Sharon, Mass., for a period of several weeks. The expense of the field work was borne partially by the Alabama Geological Survey, and funds were provided for the art work by the Geology Department of Princeton University. The drawings were prepared under the writer's supervision by Mr. Roy C. Kneeland, School of Industrial Arts, Trenton, N. J.; Miss Emily H. Tupper, of Princeton; and Messers. C. F. Brauer and W. L. Gordon, students in the Department of Architecture, Princeton University.

The localities from which the described species were obtained are as follows:

Locality 4, Sandy Ridge.—The Ripley is exposed in a low cut on the Montgomery-Greenville highway just opposite the Sandy Ridge Negro school, about $8\frac{1}{2}$ miles north of Ft. Deposit, Lowndes County. This outcrop is a calcareous clay, containing sand, glauconite, fish remains, and an abundance of megafossils, including *Exogyra costata* (Say). It bears a rich assemblage of foraminifera.

Locality 53, Barton's Bluff—About eight miles above Moscow on the Tombigbee river there is an exposure about 60 feet high in which both the Selma chalk and Ripley occur. This is a fault zone, where vertical displacement has brought the two facies into juxtaposition. The Ripley at this point is highly calcareous but presents the usual sandy, glauconitic aspect, and is very similar to the exposure at Boguechitto Creek. It contains a very rich foraminiferal fauna.

Locality 87, Prairie Bluff.—This upper Ripley locality on the Alabama river, made classic by the early work of Toumey,¹ Winchell,² and Smith³ is about six miles southeast of the town of Catherine, Wilcox County, and may be

¹ Toumey, M., First Bien. Rep. Geol. Surv. of Ala. 1850.

² Winchell, A., Proc. Amer. Assoc. Adv. Sci., vol. 10, 1856, p. 90.

³ Smith, Eugene A., "Geology of the Coastal Plain of Alabama," Ala. Geol. Surv. Rep. 1894; U. S. Geol. Surv., Bull. 43, p. 189.

reached by a local road from this village to the old Prairie post office. The exposure forms a bluff about 100 feet high where the strata dip at the unusual rate of 300 feet to the mile. At the top there is a blue limestone containing *Exogyra costata*, (Say), *Gryphea vesicularis* Lamarck, and large numbers of phosphatized shell casts. It has a thickness of eight to ten feet. Below this stratum there occurs a sandy chalk deposit approximately 20 feet thick. The lower part of this bed, near the middle of the bluff, is marked by a hard ledge made up largely of shells. The remainder of the exposure, extending to water level, consists of beds of loose, richly glauconitic, slightly argillaceous sands alternating with indurated ledges of the same materials, apparently cemented by calcareous deposits. Megafossils occur frequently but are not abundant. The foraminifera found at this locality are uniformly small, and few species are represented. The fauna occurring in the sandy beds is especially impoverished.

Locality 88, Rocky Bluff.—One mile above Prairie Bluff on the Alabama river there is an exposure of Ripley in a low cliff, called Rocky Bluff by Smith.¹ Only the basal part, about 15 feet in thickness, has been examined, since the upper beds are the same as those at Prairie Bluff. These lower strata appear to be a downward continuation of the alternating soft sands and indurated ledges of the lower part of the exposure at Prairie Bluff. They have similar marked dips, which probably in both cases may be attributed to depositional slopes. Megafossils are present, but not abundant. A restricted foraminiferal fauna has been found.

Locality 105, Red Bluff.—Just north of the boundary between Wilcox and Dallas counties on the Alabama river there is a remarkably high bluff in the lower part of which 40 to 50 feet of Ripley are exposed. This deposit is massively bedded and consists of alternating layers of dark-blue

¹ Smith, Eugene A., *Geology of the Coastal Plains of Alabama*, Ala. Geol. Survey, Report, p. 266, 1894; U. S. Geol. Surv. Bull. 43, p. 189, 1877.

micaceous clay, and clay containing varying amounts of fine sand. The clay is predominant. Large fossils are present, but not abundant. A rich microfauna has been found. The horizon appears to be low in the Ripley of this region.

Locality 106, Boguechitto Creek.—A low bluff occurs at the point where Boguechitto Creek joins the Alabama River, and a fault brings the Selma chalk up against the lower Ripley beds. The displacement appears to be about 25 feet. The Ripley strata are typical calcareous ledges, and contain numerous megafossils. The microfauna from this stratigraphic position is exceedingly rich and well developed. The upper part of the chalk exposed at this locality contains *Exogyra costata* (Say) and *E. ponderosa* Roemer. It has a great many foraminifera, but the fauna does not appear to be as rich as that of the immediately overlying Ripley beds.

DESCRIPTION OF SPECIES

Family REOPHACIDAE

Genus REOPHAX

Reophax guttifera H. B. Brady

Plate XXXI, Fig. 1.

Reophax guttifera H. B. Brady, Quart. Jour. Micr. Sci., vol. 21, 1881, p. 49; Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 295, pl. 31, figs., 10-15; Cushman, U. S. Nat. Mus., Bull. 71, pt. 1, 1910, p. 88, fig. 123.

Description.—Test typically elongate, composed of numerous chambers, pyriform in shape, connected by stoloniferous necks; wall composed of coarse sand, texture rough; aperture at the end of the last-formed neck. Length of illustrated specimen, 0.8 mm.

Remarks.—The illustrated specimen of this species from the Ripley formation consists of only two chambers, but these are very well preserved, and correspond closely to the figures cited in the synonymy. The only possibility of confusion is with *Reophax catenulatus*, which is much larger and is made up of coarser sand. So far as is known

all the previously reported occurrences are Recent, and the presence of the form in the Ripley marks its first recorded appearance as a fossil. It occurs very rarely.

Occurrence.—The illustrated specimen is from Rocky Bluff (Locality No. 88).

Family LITUOLIDAE

Genus AMMOBACULITES Cushman

Ammobaculites agglutinans (d'Orbigny)

Plate XXXI, Fig. 2.

Spirolina agglutinans d'Orbigny, For. foss. Bass. tert. Vienne, 1846, p. 137, pl. 7, figs. 10-12.

Haplophragmium agglutinans H. B. Brady, Rep. Voy. Challenger. Zoology, vol. 9, 1884, p. 301, pl. 32, figs. 19, 20, 24-26.

Ammobaculites agglutinans Cushman, U. S. Nat. Mus., Bull. 71, pa. 1, 1910, p. 115, fig. 176; U. S. Nat. Mus., Bull. 104, pa. 2, 1920, p. 60, pl. 12, fig. 3.

Description.—Test slightly compressed, planispiral, close coiled in early portion, later uncoiling; chambers distinct, later ones somewhat inflated; sutures impressed, fairly well defined; wall coarsely arenaceous; aperture terminal, simple, located at the end of uncoiled portion of test. Length of illustrated specimen 0.75 mm.

Occurrence.—This form has been found only at Red Bluff, on the Alabama river, (Locality No. 105), where it occurs in moderate abundance.

Ammobaculites reophaciformis Cushman

Plate XXXI, Fig. 3.

Ammobaculites reophaciformis Cushman, Proc. U. S. Nat. Mus., vol. 38, 1910, p. 440, figs. 12-14; U. S. Nat. Mus., Bull. No. 100, 1921, p. 92, pl. 11, fig. 3, pl. 14, fig. 3; Carnegie Inst. of Wash., Pub. No. 311, 1922, p. 20, pl. 1, fig. 1.

Description.—Cushman's description of this species is as follows: "Test free, elongate, fusiform; early portion consisting of chambers arranged in a close-coiled, planospiral series. Much compressed, later portion straight.

Reophax-like, consisting of a linear series of chambers progressively increasing in size; wall coarsely arenaceous, rough, fairly thick, aperture circular, in the middle of the terminal face, often on a neck-like portion." Length of illustrated specimen 0.8 mm.

Occurrence.—This form is fairly well distributed throughout the Alabama Ripley, but is not of abundant occurrence at any of the localities studied. The illustrated specimen is from Rocky Bluff (Locality No. 88).

Family TEXTULARIDAE

Genus TEXTULARIA Defrance

Textularia agglutinans d'Orbigny

Plate XXXI, Figs. 17, 18.

Textularia agglutinans d'Orbigny, H. B. Brady, Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 363, pl. 43, figs. 1, 2; Cushman, U. S. Nat. Mus., Bull. 71, pt. 2, 1911, p. 9, fig. 10; U. S. Geol. Surv., Bull. 676, 1918, p. 46, pl. 9, fig. 6; U. S. Nat. Mus., Bull. 100, vol. 4, 1921, p. 7, pl. 1, figs. 4, 5; U. S. Geol. Surv., Prof. Paper 129, 1922, p. 89, pl. 14, fig. 1; Plummer, Univ. of Texas, Bull. 2644, 1926, p. 66; Willard Berry, in Berry and Kelley, U. S. Nat. Mus. Mus., Proc. 1929, vol. 76, Art. 19, p. 3, pl. 2, fig. 1.

Description.—Test elongate, triangular, tapering from rounded apertural end to sharply pointed base, of medium size; chambers numerous, high, inflated; sutures impressed, clearly marked, slightly oblique; wall smoothly arenaceous, of moderate thickness; aperture is arched and somewhat rounded, located in the middle and at the base of the inner edge of the last formed chamber. Length of illustrated specimen, 0.6 mm.

Remarks.—In the arched character of its aperture the Ripley form differs from most of the figured specimens in the literature, but it resembles them closely in all other respects.

Occurrence.—The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Textularia baudouiniana d'Orbigny

Plate XXXII, Figs. 3, 4, 5.

Textularia baudouiniana d'Orbigny, Mem. Soc. geol. Fr., vol. 4, 1840, p. 46, pl. 4, figs. 29, 30; Egger, Abh. d. II. Cl. d. k. Ak. d. Wiss., vol. 21, pt. 1, 1889, p. 24, pl. 2, figs. 10, 11.

Textularis sagittula De France, var. *clonensis*, Willard Berry, in Berry and Kelley, U. S. Nat. Mus. Proc. vol. 76, Art. 19, 1929, p. 3, pl. 2, fig. 3.

Description.—Test trapeziform in side view, thickest on the elongate axis, thinning toward the periphery which is sharply angled, tapering uniformly from the broad apertural end to a pointed initial end; chambers numerous, low, sloping toward margin and curving downward slightly; wall arenaceous but very smooth, sutures fairly distinct, depressed; aperture slightly arched, limited by low rim on edge of apertural face. D'Orbigny's latin description is as follows: "Testa oblongoconică, compressă rugosă, margine carinată, antică truncată, postică acuminată, cuneiform; loculis depressis, arcuatis, supor subcon-
vexis." Length of Illustrated specimen, 0.45 mm.

Remarks.—Specimens of this species correspond closely to figures of d'Orbigny's form from the Paris Basin, and resemble in many respects Egger's figure of a representative from the Cretaceous of the Bavarian Alps. It undoubtedly is the same form that Berry has assigned to *T. sagittula*, which, according to the original figures of this species, has an elongate, flattened test, with rounded edges.

Occurrence.—The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Family VERNEUILINIDAE

Genus VERNEUILINA d'Orbigny

Verneuilina tricarinata d'Orbigny

Plate XXXI, Figs. 9, 10, 11.

Verneuilina tricarinata d'Orbigny, Mem. Soc. geol. France, vol. 4, 1840, p. 39, pl. 4, figs. 3, 4; Egger, Abh. kön. bay. Akad. Wiss., München, Cl. II., vol. 21, Bd. 1, 1899, p. 39, pl. 4, figs. 16, 17, 18.

Description.—Test pyramidal, triangular, sides flat or slightly concave, angles rather sharp, especially in the early stages, apertural end rather broad, tapering to a sharply pointed initial end; chambers triserial, early ones very small and closely spaced, increasing in size as added, the last chamber arched; sutures indistinct; wall arenaceous, rough, especially at the angles; aperture oval-shaped, central, at the inner margin of the last chamber. Length of illustrated specimen, 0.5 mm.

Remarks.—This species conforms closely to the description of the European forms, differing from them only in not having the apertural end sharply truncated. The concave faces, acute angles, sharp apex, and rough surface are characteristics mentioned in all the descriptions.

Occurrence.—The illustrated specimen is from Sandy Ridge (Locality No. 4).

Genus GAUDRYINA d'Orbigny

Gaudryina rugosa d'Orbigny

Plate XXXI, Fig. 16.

Gaudryina rugosa d'Orbigny, Mem. Soc. geol. Fr., vol. 4, 1840, pp. 44, pl. 4, figs. 20, 21; Beissel, Abbandl. d. geol. Landesanstalt, new series, vol. 3, 1891, p. 69, pl. 8, figs. 40-42; Chapman, Jour. Roy. Micr. Soc. 1892, p. 4, pl. 11, figs. 9a, b; Egger, Abbandl. d. II., Cl. d. k. Ak. d. Wiss., vol. 21, pt. 1, 1899, p. 37, figs. 14, 15; Plummer, Univ. of Tex., Bull. 3101, 1931, p. 135, pl. 8, fig. 11; Cushman, Tenn., Geol. Surv., Bull. 41, 1931, p. 20, pl. 1, figs. 9, 10.

Description.—Test elongate, laterally compressed, apertural end wide and sharply arched, tapering gradually to a pointed initial end, triserial portion prominent, extending over about a third of the total length; chambers few, 3 or 4 in biserial part of test, high, compressed, very little inflated, those in triserial part small, compact, 5 to 6 in number; sutures impressed, usually indistinct; wall coarsely arenaceous, rough; apertures highly arched, in a depression on the sloping inner face of the last-formed chamber. Length of figured specimen 1.2 mm.

Remarks.—This characteristic Cretaceous species is represented by typical specimens, as figured in the literature cited, and occurs very well preserved. The flattened character of the biserial portion of the test, its saggitate shape, and the prominence of the triserial chambers are especially notable features which make identification of the species easy.

Occurrence.—The form occurs abundantly in the Ripley. The illustrated specimen is from Sandy Ridge (Locality No. 4).

Gaudryina laevigata Franke

Plate XXXI, Fig. 21.

Gaudryina laevigata Franke, A., Zeitschr. Deutsch. Geol. Ges., vol. 66, 1914, p. 431, pl. 37, figs. 1, 2.

Description.—Test stout, short, slightly compressed, tapering uniformly from a rounded apertural end; length of adult form about twice the greatest breadth; chambers in early triserial stage small and short, later biserial chambers making up the greater part of the test, gradually increasing in size as added, oval in shape, slightly inflated; sutures impressed, fairly distinct; wall coarsely arenaceous, rather smoothly finished; aperture a small oval-shaped opening situated at the base and inner margin of the last-formed chamber. Length of illustrated specimen, 0.6 mm.

Remarks.—This form closely resembles the figures and descriptions of the species from the German Cretaceous where it occurs with *G. rugosa*. Another species which it approaches is *G. scabra* H. B. Brady,¹ but it differs from Brady's form principally in the greater inflation of its chambers and its more sharply pointed apical end. *G. bradyi* Cushman² also is a similar species, but the Ripley form does

¹ Brady, H. B. Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 381, pl. 46, fig. 7.

² Cushman, U. S. Nat. Mus. Bull. No. 71, pt. 2, 1911, p. 67, fig. 107.

not have its characteristic rounded chambers, and possesses a larger aperture. *G. laevigata* has characteristics intermediate between those of *G. rugosa* and *G. pupoides*.

Occurrence.—The species occurs frequently in the Ripley formation. The figured specimen is from Barton's Bluff (Locality No. 53).

Gaudryina gradata Berthelin

Plate XXXI, Figs. 27, 28.

Gaudryina gradata Berthelin, Mem. Soc. geol. France, ser. 3, No. 5, p. 24, pl. 1, fig. 6; Egger, Abh. d. II. Cl. d. k. Ak. d. Wiss., vol. 21, pt. 1, 1899, p. 38, pl. 4, figs. 4-6; Plummer, Univ. of Texas, Bull. 3101, 1931, p. 136, pl. 8, fig. 12.

Description.—Test elongate, slightly compressed, composed of numerous chambers, increasing in size as added, slightly flattened, initial end pointed, edges broadly rounded; wall rather smoothly finished; sutures depressed; aperture at the inner margin of the last-formed chamber, slightly elongate, arched. Length of figured specimen, 0.9 mm.

Occurrence.—The occurrence of this species in the cretaceous of France, Bavaria, Texas, and Alabama suggests that it may have considerable value as a guide fossil. The form occurs rarely in the Ripley formation. The illustrated specimen is from Sandy Ridge, (Locality No. 4).

Gaudryina rudita n. sp.

Plate XXXI, Figs. 19, 20.

Description.—Test elongate, slightly compressed, broad at the apertural end, apical end bluntly pointed, tri-serial part small, short, biserial portion much longer, slightly inflated; chambers gradually increasing in size as added, rounded, overlapping; sutures impressed, sometimes partially concealed by the rough coating of sand; wall finely arenaceous, covered with coarse sand grains, surface rough; aperture in a rounded depression extending from

the inner margin well into the face of the last chamber. Length of holotype, 0.61 mm.

Remarks.—This species differs from *G. rugosa* of the Ripley in the greatly reduced early, triserial stage, and in having a much rougher surface. There is a resemblance between this form and the species figured by Egger¹ as *G. rugosa*. The latter, however, is longer, is more slender, has more chambers, and appears not to be as roughly finished. The new species also is similar in general appearance to *G. convexa* Cushman,² but the aperture is distinctly different, and the faces of *G. rudita* are not sufficiently convex to produce any confusion of the forms.

Occurrence.—This species is known only from the upper part of the Ripley formation at Prairie Bluff and Rocky Bluff on the Alabama River. The holotype is from Rocky Bluff Locality No. 88).

Family LAGENIDAE

Genus ROBULUS Montfort

Robulus nodosus Reuss

Plate XXXII, Figs. 16, 17.

Robulina nodosa Reuss, Sitz. d. k. Akad. Wiss, Wien, vol 39, 1862, p. 78, pl. 9, figs. 6a, b.

Cristellaria nodosa Chapman, Journ. Roy. Mic. Soc., 1896, p. 4, pl. 1, figs. 5a, b.

Description.—Test biconvex, close-coiled unbinate, keel subangular, indented; chambers radial, eight to ten in last whorl; sutures radiating from umbo, raised, forming narrow ridges of clear shell material, terminating at the periphery in a large projecting knob or node; wall between the sutures smooth, opaque; apertural face triangular, flat, angular at the edges; aperture double, con-

¹ Egger, Abh. kön. bay. Akad. Wiss., Munich, Cl. II., vol. 21, Bd. 1, 1899, p. 37, pl. 4, figs. 19, 20.

² Cushman, U. S. Nat. Mus. Bull. No. 71, pt. 2, 1911, p. 66, fig. 105.

sisting of a small radiate aperture at the peripheral angle and an elongate slit extending from the apex well down into the apertural face. Diameter of figured specimen, 1.2 mm.

Remarks.—The specimens of this form from the Ripley formation correspond very closely with Chapman's figures of this species from the Gault of Folkstone. The resemblance to Reuss' figures, which seem to be conventionalized, is not so evident, although they also correspond in general characterization. Restoration of the original genus is necessary in view of the typical Robuline character of the aperture.

Occurrence.—This species is of frequent occurrence in the lower part of the Ripley in central Alabama, and promises to be a very useful fossil for stratigraphic purposes. The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Genus LENTICULINA Lamarck

Lenticulina rotulata Lamarck

Plate XXXII, Fig. 9.

Lenticulites rotulata Lamarck, Ann. Mus., vol. 5, 1804, p. 188, No. 3; vol. 8, 1806, p. 62, fig. 11.

Cristellaria rotulata d'Orbigny, Men. Soc. Geol. France, Ser. 1, vol. 26, 1840, pl. 2, figs. 16-18; Cushman, U. S. Nat. Mus., Bull. No. 71, pt. 3, p. 66, pl. 35, fig. 3; U. S. Geol. Surv., Prof. Paper No. 129, 1921, p. 130, pl. 32, fig. 1; U. S. Nat. Mus., Bull. No. 104, pt. 4, 1923, p. 108, pl. 22, fig. 2; Cont. Cush. Lab., vol. 3, pt. 3, 1927, p. 142, pl. 28, figs. 7a, b; Plummer, Univ. Tex., Bul. 2644, 1926, p. 91, pl. 7, figs. 8a, b; Chapman, New Zealand Geol. Surv., Pal. Bull. N. 11, 1926, p. 64, pl. 4, figs. 16a, b.

Description.—Test round, biconvex, close-coiled, periphery acute, sometimes partially carinate, apertures of early chambers often visible as clear nodes at the margin, a transparent umbo usually present at the center of the test; chambers pyramidal in shape, base straight or slightly curved; sutures visible as narrow lines, straight or curved, conforming to the outline of the chambers, usually flush

with surface of test, rarely slightly depressed or elevated; wall smooth, thin; apertural face truncate, usually flat with an acute margin; aperture at the peripheral angle, radiate. Diameter of illustrated specimen, 1.0 mm.

Remarks.—This exceedingly common representative of the foraminifera shows greater variability in treatment than any other species found on the Ripley. Fundamental features such as its lenticular shape, the peculiar manner in which the chambers overlap, and the radiate aperture are quite constant, but characteristics other than these appear to be decidedly indefinite. Hairsplitting treatment of the forms doubtless would yield a number of additional species. The specimens from the Ripley which have been selected as representative correspond very closely to the original type of Lamarck as figured by Cushman. They occur very abundantly.

Lenticulina rotulata has a long geologic record, ranging from Lias through the Pliocene in Europe, and from the Cretaceous through the Pliocene in this country. Chapman records it from many localities in the Eocene and Miocene of New Zealand. Recent representatives are abundant in the present seas, notably, as shown by Cushman, in the warmer portions of the western Atlantic, the Caribbean, and the Gulf of Mexico.

Occurrence.—The Ripley formation bears this species in large numbers at almost every locality in Alabama from which samples have been studied. Its cosmopolitan characteristic deprives the form of practical stratigraphic value. The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Lenticulina gibba d'Orbigny

Plate XXXI, Fig. 12.

Cristellaria gibba d'Orbigny, Ann Sci. Nat., vol. 7, 1826, p. 292; Models, 1826, No. 17; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 546, pl. 69, figs. 8, 9; Chapman, Jour. Roy. Mic. Soc., 1896, p. 4, pl. 1, fig. 7; New Zealand Geol. Surv., Pal. Bull. 11, 1926, p. 61, pl. 1, figs. 14a, b; Bagg, Maryland Geol. Surv., Eocene, 1901,

p. 241, pl. 63, fig. 4; U. S. Geol. Surv., Bull. No. 513, 1912, p. 66, pl. 19, fig. 4; Cushman, U. S. Nat. Mus., Bull. No. 71, pt. 3, 1913, p. 69, pl. 35, fig. 1; U. S. Geol. Surv., Bull. No. 676, 1918, p. 10, pl. 2, fig. 6; U. S. Nat. Mus., Bull. No. 100, vol. 4, 1921, p. 228, pl. 45, fig. 1; U. S. Nat. Mus., Bull. No. 104, pt. 4, 1923, p. 105, pl. 25, fig. 4; Plummer, Univ. Tex., Bull. 2644, 1926, p. 94.

Description.—Test close-coiled, slightly elongate, somewhat compressed, periphery acute; chambers curving, 7-8 in last coil, wall smooth; sutures sometimes slightly raised, curving away from aperture; apertural face wide, triangular in shape, truncate; aperture at the peripheral angle, protruding, radiate. Length of illustrated specimen, 0.45 mm.

Remarks.—This widely reported species occurs abundantly in the Ripley at nearly all the localities from which samples have been studied. It is a cosmopolitan form, adapting itself readily to various environments, and reflecting only slight changes in the character of the test.

Occurrence.—The geologic range of the species extends from Lower Cretaceous to the present. Reuss found it in the Hils formation in Germany. Chapman records it in the Neocomian of Surry, and in the Eocene of New Zealand. Bagge found it in the Eocene of the Atlantic Coastal Plain and in the Pliocene of California. Plummer reports the species as occurring frequently in the Midway of Texas. Recent representatives are known from many localities in the present seas. The cosmopolitan nature of the form renders it of little value for stratigraphic purposes. The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Lenticulina crepidula (Fichtel and Moll)

Plate XXXII, Fig. 6.

Nautilus crepidula Fichtel and Moll. Test. Micr., 1803, p. 107, pl. 19, figs. g-i.

Cristellaria crepidula H. B. Brady, Rep. Voy. Challenger, Zoology vol. 9, 1884, p. 542 pl. 67, figs. 17, 19, 20; pl. 68, figs. 1, 2; Chapman, Jour. Roy. Mic. Soc., 1894, p. 648, pl. 9, figs. 8a, b; Cushman, U. S. Nat. Mus., Bull. No. 71, 1913, p. 70, pl. 29, figs. 5, 6; pl. 31, figs. 2-5;

U. S. Nat. Mus., Bull. No. 100, vol. 4, 1921, p. 248, pl. 50, figs. 4, 5;

U. S. Nat. Mus., Bull. No. 104, pt. 4, 1923, p. 117, pl. 35, figs. 3, 4.

Description.—Test elongate, slightly curved, laterally compressed, early chambers coiled, later ones uncoiled, increasing in size as added, few, seven to eight in number; sutures slightly impressed, sloping obliquely across test between the later chambers; wall smooth, polished; aperture protruding, terminal, radiate. Length of figured specimen, 1.2 mm.

Remarks.—This is an exceedingly common form from the Cretaceous of Europe which has been recorded repeatedly by earlier works. Chapman states that its range extends back to the Lias, and Cushman reports it as a recent species in the region of the Philippines, the north Pacific, the western Atlantic, and the Gulf of Mexico. The latter occurrence is significant because of its proximity to the Ripley deposits.

Occurrence.—This species occurs rarely in the lower part of the Ripley in the Alabama river section. The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Lenticulina longiforma (Plummer) (?)

Plate XXXI, Fig. 8.

Cristellaria longiforma Plummer, Univ. Tex., Bull. 2644, 1926, p. 102, pl. 13, figs. 4a, b.

Description.—Test elongate, stout, laterally compressed, early chambers slightly coiled, three or four in number, later chambers uniserially arranged, forming a straight portion of the same width at the coiled stage; sutures limbate, slightly oblique, sloping away from the aperture; aperture marginal, protruding, radiate. Length of figured specimen, 1.6 mm.

Remarks.—The Ripley specimens of this form agree so closely with Plummer's description and figures that the naming of a new variety of the species does not seem to be justified despite the fact that there are slight variations.

The sutures on the Ripley form do not slope as much as those of the figured specimen of Plummer, and the coiled portion is larger and broader. Otherwise they correspond almost identically. The original specimens came from the Wilcox, Eocene, of Texas where they have been reported as excellent markers of the upper faunule.

O c c u r r e n c e.—The occurrence of this species in the Ripley of Alabama extends the possible range of the form very much and deprives it of any value as a key fossil in that region at the present time. It has been found only rarely in the upper part of the formation. The illustrated specimen is from Barton's Bluff (Locality No. 53).

Genus MARGINULINA d'Orbigny

Marginulina elongata d'Orbigny

Plate XXXII, Fig. 2.

Marginulina elongata d'Orbigny, Mem. Soc. geol. France, ser. 1, vol. 4, p. 17, pl. 1, figs. 20-22, 1840; Franke, Abhn. Preuss. Geol. Landes., vol. 3, p. 76, pl. 7, fig. 5, 1928; Cushman and Church, Proc. Calif. Acad. Sci., ser. 4, vol. 18, p. 506, pl. 38, figs. 1-3, 1929; Cushman, Tenn. Geol. Surv., Bull. 41, p. 26, pl. 2, figs. 10a, b, 1931.

Description.—Test elongate, subcylindrical, slightly compressed in early stages, later stages inflated; early chambers closely coiled, later uncoiled and nearly globular in shape; sutures distinct, depressed in retilinear part of test, oblique, sloping away from the periphery; wall, calcareous, smooth; aperture eccentric, at the peripheral angle, radiate, protruding. Length of illustrated specimen 0.75 mm.

Remarks.—Cushman's Recent form, *Marginulina bacheii*, which occurs abundantly along the Atlantic coast and in the Gulf of Mexico closely approaches this species. The chief difference is in the shorter, stouter build of the *M. elongata*, and in the smaller numbers of chambers making up its test. In all normal specimens examined, there are only four chambers in the uncoiled part of the shell, and four or five in the visible coiled portion.

Occurrence.—The species is fairly abundant in the Ripley beds exposed at the mouth of Boguechitto Creek, on the Alabama river. The illustrated specimen was obtained at this locality (Locality No. 106).

Genus DENTALINA d'Orbigny

Dentalina sulcata (Nilsson)

Plate XXXI, Fig. 4.

Nodosaria sulcata Nilsson, S., Kongl. Vetenskapsacademiens Handlingar, Stockholm, 1825, p. 341.

Dentalina sulcata d'Orbigny, Mem. Soc. Geol. France, Ser. 1, vol. 4, 1840, pl. 1, figs. 10-13, p. 15.

Description.—Test elongate, slender, tapering, slightly arcuate; chambers numerous, ten or more, early ones elongate, nearly cylindrical, later ones becoming shorter and inflated, the last chamber slightly reduced in size, surface nearly smooth, with long tapering neck; sutures in the early stages very slightly constricted, deeply impressed between late chambers, septae visible as broad bands of clear shell material; wall ornamented with about eight strong slightly flaring costae extending longitudinally from the apical end to the last chamber, costae weakly developed on the last chamber; aperture nearly central, protruding, small, round. Length of figured specimen, 1.8 mm.

Remarks.—In general appearance this form is similar to the average figure of *Nodosaria vertebralis* (Batsch) as shown in later literature and resembles closely the figures of recent representatives of the Batsch species given by Flint¹ and Cushman.² The Ripley specimens differ from *N. vertebralis*, as usually figured, in having chambers which are inflated, even the early ones showing a slight tendency toward inflation, and in possessing definitely constricted sutures.

¹ *Nodosaria vertebralis* Flint, Jas. M. Rep. U. S. Nat. Mus., 1897 (1899). p. 312, pl. 57, fig. 5.

² *Nodosaria vertebralis* Cushman, J. A., U. S. Nat. Mus., Bull. No. 100, 1921, p. 211, pl. 40, fig. 2.

Occurrence.—*D. sulcata* occurs sparsely in the upper part of the Ripley formation. The illustrated specimen is from Barton's Bluff (Locality No. 53).

Dentalina inornata d'Orbigny

Plate XXXI, Figs. 7, 14.

Dentalina inornata d'Orbigny, Foram. Foss. Vienne, 1846, p. 44, pl. 1, figs. 50, 51; Cushman, Foraminifera, Their Classification and Economic Use, 1928, pl. 24, figs. 12a, b; Contr. Cush. Lab. Foram. Res., vol. 5, pt. 4, 1929, p. 85, pl. 12, fig. 21.

Nodosaria inornata (d'Orbigny), Egger, Abh. d. II. Cl. d. k. Ak. d. Wiss. Bd. 21, Abth. 1, 1899, p. 57, pl. 6, fig. 6.

Description.—Test elongate, slender, arcuate, tapering, initial end rounded; sutures oblique, impressed between later chambers; chambers increasing in size as added, later ones slightly inflated; aperture eccentric, terminal, radiate. Length of specimen shown is fig. 7, 1.1 mm; length of specimen in fig. 14, 1.5 mm.

Remarks.—The test of the Ripley specimens of this species when viewed from the side have the appearance of a twisted rope or cord of tapering diameter. They correspond closely to the figure of d'Orbigny's type, which came from the Miocene of the Vienna Basin. Other occurrences are reported from the Cretaceous of the Bavarian Alps, and the Tertiary of Venezuela.

Occurrence.—The species occurs rarely in the Ripley. The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Dentalina tenuicollis Reuss

Plate XXXI, Fig. 6.

Dentalina tenuicollis Reuss, Zeit. d. Deut. geol. Ges., vol. 7, 1855, p. 267, pl. 8, fig. 11.

Nodosaria tenuicollis Reuss, Sitz. d. k. Akad. d. Wiss., in Wien, math.-naturw. cl. Bd. 52, Abth. 1, 1865 (1866), p. 452, pl. 1, fig. 6.—Der-vieux, Bol. della Soc. Geol. Italica, vol. 12, 1893, p. 617, pl. 5, fig. 51.—(?) Egger, Abh. d. II. Cl. d. k. Akad. d. Wiss. Bd. 21, Abth. I., 1899, (1902), p. 67, pl. 7, fig. 31.

Description.—Test elongate, slightly arcuate, apertural end rounded, apical end bluntly pointed; chambers in early stages short, cylindrical, becoming longer and very slightly inflated in later stages; sutures narrow, transverse, appearing as dark lines, somewhat impressed between later chambers; wall smooth, finely punctate, polished; aperture slightly protruding, somewhat eccentric, round, radiate. Length of illustrated specimen, 0.95 mm.

Remarks.—This well preserved form closely approaches Reuss' figured specimen from the Cretaceous at Kustendsche, but differs from it in not tapering as sharply toward the apical end. Reuss' type of *D. tenuicollis* is from the Cretaceous at Mecklenburgs. Its final chambers are not inflated, as are those of the form figured from Kustendosche, but are flush, with the last one tapering to the aperture. This species differs from *D. reussi* in having shorter, less inflated chambers, and sutures only slightly depressed.

Occurrence.—It occurs rarely in the Ripley at the mouth of Boguechitto Creek, Locality No. 106.

Dentalina pauperata d'Orbigny

Plate XXXI, Fig. 13.

Dentalina pauperata d'Orbigny, Foram. Foss. Vienne, 1846, p. 46, pl. 1, figs. 57, 58.

Nodosaria pauperata Cushman, U. S. Nat. Mus., Bull. No. 71, pt. 3, 1913, p. 51, pl. 25, fig. 7; U. S. Nat. Mus., Bull. No. 104, pt. 4, 1923, p. 72, pl. 14, fig. 13; Halyard in Heron-Allen and Earland, Mem. and Proc. Manchester Lit. Phil. Soc., vol. 62, 1917, p. 71, pl. 4, figs. 8, 9; Plummer, Univ. Tex. Bull., 2644, 1926, p. 79, pl. 4, fig. 11.

Description.—Test elongate, slightly arcuate, tapering from a rounded apertural end to a bluntly pointed apical end; chambers in early portion short, cylindrical, later becoming longer and inflated; sutures in cylindrical part of test narrow, transverse, appearing as dark lines, impressed between later chambers; wall smooth, finely punctate, polished; aperture slightly protruding a little eccentric, round, radiate. Length of figured specimen 1.5 mm.

Remarks.—This beautifully preserved form is very close to d'Orbigny's original figure, differing from it only in having a shorter apertural projection, and in lacking the apical spine which may be broken from the specimens. For this reason, and because of its arcuate shape, the original name has been restored. It is practically identical with one of Halyard's specimens (pl. 4, fig. 9) from the Eocene at Biarritz. *Dentalina tenuicollis* Reuss is regarded as a closely related species originally described from the Cretaceous at Kustendsche.

Occurrence.—Plummer states that in Texas the species is confined to the Upper Midway formation where it is a frequent form. It is reported from the Lias and Tertiary in Europe in addition to the Cretaceous. The form is found very rarely in the lower part of the Ripley. The figured specimen is from Rocky Bluff (Locality No. 88).

Dentalina vertebralis (Batsch)

Plate XXXII, Fig. 8.

Nautilus (Orthoceras) vertebralis Batsch, Conch. des Seesandes, 1781, p. 3, No. 6, pl. 2, fig. 6.

Nodosaria vertebralis H. B. Brady, Rep. Voy. Challenger, Zoology vol. 9, 1884, p. 514, pl. 63, fig. 35; pl. 64, figs. 11-14; Egger. Abh. d. II. Cl. d. k. Akad. d. Wiss. XXI., Bd. I., Abth. 1893, p. 344, pl. 11, fig. 36; Cushman, U. S. Nat. Mus. Mus., Bull. No. 71, 1913, P. 60; pl. 32, fig. 1; Carnegie Inst. Wash., Pub. 291, 1919, p. 35, pl. 7, figs. 3-7; U. S. Nat. Mus., Bull. No. 100, vol. 4, 1921, p. 211, pl. 38, figs. 2, 3; U. S. Nat. Mus., Bull. No. 104, pt. 4, p. 86, pl. 14, fig. 6; Halyard, in Heron-Allen and Earland, Mem. and Proc. Manchester Lit. and Phil. Soc., vol. 62, No. 6, 1917, p. 76; Plummer, Univ. Tex., Bull. 2644, 1926, p. 88, pl. 5, fig. 10.

Description.—Test elongate, slender, tapering, slightly arcuate, apical end pointed; chambers numerous, long and cylindrical in early stages, later becoming very slightly inflated; sutures constricted only between last few chambers, septae visible as wide bands of clear shell material. Wall ornamented with about eight sharp, high costae extending from the apical end to the aperture, crossing the sutures with only faint indentation; aperture on a protrud-

ing neck, somewhat eccentric, round, radiate. Length of figured specimen, 4.5 mm.

Occurrence.—This species is known to range through the geologic column from the Cretaceous to the present. Recent forms have been reported from the Gulf of Mexico in moderately deep waters. It occurs frequently in the Ripley near the base and middle of the formation. The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Genus *NODOSARIA* Lamarck

Nodosaria raphanus (Linnaeus)

Plate XXXI, Fig. 5.

"*Cornu Hammonis erectum*" Plancus Conch. Min. 1739, pl. 1, fig. 6.

Nautilus raphanus Linnaeus, Syst. Nat., 12th Ed. 1767, p. 1164, No. 283.

Nodosaria raphanus H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 512, pl. 64, figs. 6-10; Cushman, U. S. Nat. Mus. Bull. No. 71, pt. 3, 1913, p. 59, pl. 26, figs. 12, 13; U. S. Nat. Mus., Bull. No. 100, vol. 4, 1921, p. 210, pl. 37, figs. 5-7; U. S. Nat. Mus., Bull. No. 104, pt. 4, 1923, p. 84, pl. 15, fig. 6; Halyard (Heron-Allen and Earland), Mem. and Proc. Manchester Lit. and Phil. Soc., vol. 62, No. 6, 1917, p. 77.

Description.—Test rather stout, somewhat tapering, rounded at the apertural end, initial chamber rounded, bearing a short spine; chambers short, cylindrical, few, seven to ten in number; sutures slightly impressed, septae visible as narrow bands of pellucid shell material; wall marked by six to eight strongly developed costae extending the length of the test, typically wide, with sharp edge; aperture terminal, low, round. Length of illustrated specimen, 1.2 mm.

Occurrence.—Typical specimens of this species occur with moderate frequency in the upper part of the Ripley formation. It is reported by Brady as the oldest of the Nodosarian forms, having been found in the Upper Trias. It ranges through the Cretaceous and Tertiary to the present. Recent representatives have been found in the Atlantic near the Azores and the West Indies, and in the

Pacific near the Philippines. The illustrated specimen is from Barton's Bluff (Locality No. 53).

Nodosaria pyrula d'Orbigny var. *semirugosa* d'Orbigny

Plate XXXII, Fig. 13.

Nodosaria semirugosa d'Orbigny, Foram. Foss. Vienne, 1846, p. 34, pl. 1, Figs. 20-23; Cushman, U. S. Nat. Mus., Bull. No. 71, pt. 3, 1913, p. 50, pl. 26, figs. 4-8.

Nodosaria pyrula d'Orbigny var. *semirugosa* Cushman, U. S. Nat. Mus., Bull. No. 100, vol. 4, 1921, pl. 33, figs. 6, 7; U. S. Nat. Mus., Bull. No. 104, pt. 4, 1923, p. 70, pl. 16, fig. 5.

Description.—Test elongate, slender, made up of several chambers, uniform in size, globular or pyriform in shape, and connected by stoloniferous tubes or necks; surface ornamented with longitudinal costae extending from the narrow tubular portion to the middle of the globular chambers, remainder of surface smooth; aperture at the end of the last long, slender neck. Length of illustrated specimen, 0.75 mm.

Remarks.—Fragments of this species occurring in the lower Ripley are exceedingly well preserved, even retaining the original hyaline appearance in large measure, and showing the original gloss.

Occurrence.—The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Nodosaria pyrula d'Orbigny var. *longi-costata* Cushman

Plate XXXII, Fig. 12.

Nodosaria pyrula d'Orbigny var. *longi-costata* Cushman, Proc. U. S. Nat. Mus., vol. 5, 1917, p. 653; U. S. Nat. Mus. Bull. No. 100, 1921, p. 188, pl. 33, figs. 8, 9.

Description.—Test elongate, slender, consisting of several chambers of uniform size, globular or pyriform in shape, and connected by narrow stoloniferous tubes; wall thick, ornamented with longitudinal costae extending over the surface of the entire shell from end to end; aperture at the end of the last formed neck. Length of illustrated form, 1.05 mm.

Remarks.—This variety of *N. pyrula* occurs in association with the variety *semirugosa*. In view of the fact that all gradations between these two forms and *N. pyrula* are known, as has been pointed out by Cushman,¹ the value of the subdivisions seems doubtful. Flint's recent species is reported from moderately deep water in the Gulf of Mexico.

Occurrence.—The form occurs very rarely in the lower Ripley of the Alabama river section. The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Genus SARACENARIA Defrance

Saracenaria italica Defrance

Plate XXXII, Fig. 18.

Saracenaria italica Defrance, Dict. Sci. Nat., vol. 32, 1824, p. 177, vol. 47, 1827, p. 344; Cushman, Jour. Pal., vol. 5, 1931, p. 305, pl. 34, figs. 15, 16.

Description.—Test elongate, trihedral, early chambers close-coiled, later ones uncoiling and rest extending back to early volutions; wall smooth, early sutures flush, later ones slightly depressed; face of the last-formed chamber triangular; aperture at the peripheral angle, round, radiating. Length of figured specimen, 1.2 mm.

Remarks.—Ripley specimens of the species correspond very closely with this and other descriptions from the literature. The only variation is in the aperture which appears to be somewhat larger than that of most figured forms.

Occurrence.—The illustrated specimen is from Barton's Bluff (Locality No. 53).

Genus VAGINULINA d'Orbigny

Vaginulina legumen (Linnaeus)

Plate XXXI, Fig. 15.

Nautilus legumen Linnaeus, Syst. Nat., 10th Ed. p. 711, No. 248.

Vaginulina Legumen H. B. Brady, Rep. Voy. Challenger, Zoology, vol 9,

¹ Cushman, U. S. Nat. Mus., Bull. No. 100, 1921, p. 188.

1884, p. 580, pl. 66, figs. 13-15; Cushman, U. S. Nat. Mus., Bull. No. 71, pt. 3, 1913, p. 80, pl. 39, fig. 4; U. S. Nat. Mus., Bull. No. 100, vol. 4, 1921, p. 257, pl. 41, fig. 3; U. S. Nat. Mus., Bull. No. 104, pt. 4, 1923, p. 133, pl. 37, fig. 5; Plummer, Univ. Tex., Bull. 2644, 1926, p. 109, pl. 6, fig. 2.

Description.—Test elongate, slightly arcuate, tapering, apical end bearing a short, sharp spine, apertural end somewhat inflated; chambers compactly arranged, increasing gradually in size as added; sutures oblique, appearing as narrow dark lines in early stages, later becoming slightly impressed; wall thin, smooth, retaining much of the original polish, aperture eccentric, slightly elongate, radiate. Length of illustrated specimen, 0.7 mm.

Remarks.—This form is readily distinguished from the variety *V. legumen* var. *elegans*, by its more slender contour and the presence of the apical spine. As Mrs. Plummer¹ points out, it is distinguished from *V. badensis* d'Orbigny by less lateral compression and more nearly horizontal sutures, and from *V. arcuata* Brady by having greater curvature and less compression.

Occurrence.—This species has been reported from the Triassic to the present. Recent forms are known in the northern part of the Gulf of Mexico, in the Atlantic, and in the Pacific. It is found in the lower and middle part of the Ripley formation of Alabama in very limited numbers. The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Vaginulina legumen var. *elegans* d'Orbigny

Plate XXXII, Fig. 1.

Vaginulina elegans d'Orbigny, Modeles, No. 54, 1826; Ann. Sci. Nat., vol. 7, 1826, p. 257.

Vaginulina legumen var. *elegans* Cushman, U. S. Nat. Mus., Bull. No. 100, 1921, vol. 4, p. 258, pl. 41, fig. 4; U. S. Geol. Surv., Prof. Paper No. 129, pp. 93, 131, pl. 17, fig. 1; U. S. Geol. Surv., Prof. Paper No. 133, 1923, p. 30, pl. 4, fig. 8; Plummer, Univ. Tex., Bull. 2644, 1926, p. 110, pl. 6, fig. 1.

¹ Plummer, Univ. Tex. Bull. 2644, 1926, p. 109.

Description.—Test elongate, tapering slightly from a rounded apertural end to a bluntly pointed initial chamber, horizontal section round; chambers numerous, nine to ten, early ones short, later ones longer, last one slightly inflated; sutures appearing as dark, pellucid bands crossing the test horizontally, last one very slightly impressed; wall smooth, retaining much of its original polish; aperture rounded, eccentric, radiate. Length of illustrated specimen; 1.3 mm.

Occurrence.—The Ripley bears this species in abundance throughout the section in western Alabama. Its geologic range extends back to the Triassic. Recent forms have been reported from the region of the Philippines in the Pacific. The illustrated specimen is from Red Bluff (Locality No. 105).

Genus FRONDICULARIA Defrance

Frondicularia lanceola Reuss

Plate XXXII, Fig. 7.

Frondicularia lanceola Reuss, Sitz. d. k. Akad. Wiss. Wien. Bd. 40, 1860, p. 168, pl. 5, fig. 1; Chapman, Journ. Roy. Mic. Soc., 1894, p. 167, pl. 3, fig. 15; Egger, Abh. kön. bay. Akad. Wiss., München, Cl. II., vol. 21, Bd. 1, 1899, p. 87, pl. 15, figs. 9, 10; Cushman, Contr. Cush. Lab. Foram. Res., vol. 6, pt. 2, 1930, p. 38, pl. 5, figs. 18, 19.

Description.—Test elongate, slender, compressed, wider near the apertural end, initial end pointed, border thin, slightly rounded, somewhat indented at the sutures; initial chamber oval, much elongated; bearing several longitudinal ridges on the surface and a short apical spine, later chambers few in number, shaped like inverted Vs, increasing in size as added, margins acute except near the aperture on the last chamber where they are flat; sutures slightly elevated near the axis of the test, becoming somewhat impressed toward the borders; wall smooth, transparent to translucent; aperture terminal, round. Length of illustrated specimen, 1.8 mm.

Remarks.—A single representative of this species has been obtained from the Ripley formation. The form

appears to be a young specimen of the typical *F. lanceola* of Reuss, but is identical, even to the number of chambers, with the figure given by Egger. Chapman's form is not typical. All the known occurrences of this species are confined to the Cretaceous.

Occurrences.—The illustrated specimen is from the lower beds of the Ripley formation at the mouth of Boguechitto Creek on the Alabama river (Locality No. 106).

Genus *LAGENA* Walker and Jacob

Lagena hispida Reuss

Plate XXXII, Fig. 14.

Lagena hispida Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pl. 1, 1862 (1863), p. 335, pl. 6, figs. 77-79; Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II., vol. 18, 1893, p. 324, pl. 10, fig. 26; Cushman, U. S. Nat. Mus., Bull. No. 71, pt. 3, 1913, p. 13, pl. 4, figs. 45; pl. 5, fig. 1; Proc. U. S. Nat. Mus., vol. 56, 1919, p. 608; U. S. Nat. Mus., Bull. No. 104, pt. 4, 1923, p. 26, pl. 4, figs. 7, 8.

Description.—Test globular, slightly ovate, with a long tubular neck projecting from apertural end; surface covered with fine, short spines uniformly distributed; wall thin. Length of illustrated specimen, 0.7 mm.

Occurrence.—This delicate species is very well preserved with all its original characteristics in the lower Ripley. It is rare, however, and is known only from the mouth of Boguechitto Creek in the Alabama river section (Locality No. 106).

Family POLYMORPHINIDAE

Genus *GUTTULINA* d'Orbigny

Guttulina problema d'Orbigny

Plate XXXI, Figs. 23, 24.

Guttulina problema d'Orbigny, Anna. Sci. Nat. vol. 7, 1826, p. 266, No. 14; Cushman and Schenck, Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 17, 1928, p. 310, pl. 43, figs. 9-11; Cushman and Ozawa, U. S. Nat. Mus., Proc., vol. 77, Art. 6, 1930, p. 19, pl. 2, figs. 1-6; pl. 3, figs. 1a-c.

Description.—Test ovate, elongate, somewhat compressed, apertural end slightly produced, initial end

rounded; chambers few, outer ones partially enveloping, elongate, somewhat inflated; sutures partially impressed, visible as faint lines showing through the transparent outer layer of shell material; wall smooth, often retaining its original polish; aperture terminal, slightly protruding, oval, radiate. Length of illustrated specimen, 0.4 mm.

Remarks.—This very common species is distinctive, and unlikely to be confused with any of the other Ripley forms. The specimens from this formation correspond closely to those figured in the literature, including d'Orbigny's original drawings.

G. problema has a wide range both geologically and geographically. It has been found in rocks of all ages since the Cretaceous, and is common in the present seas. The distribution of the reported occurrences is world-wide.

Occurrence.—The species occurs throughout the Ripley formation in central and western Alabama, and probably extends to the eastern extremity of the strictly marine beds. The figured specimen is from Red Bluff on the Alabama river (Locality No. 105).

Genus GOBULINA d'Orbigny

Gobulina inaequalis Reuss

Plate XXXII, Figs. 25, 26.

Gobulina translucida d'Orbigny, Ann. Sci. Nat., vol. 9, 1826, p. 267, No. 25.

Gobulina inaequalis Reuss, Denkschr. K. Akad. Wiss. Wien, vol. 1, 1850, p. 377, pl. 48, fig. 9; Cushman and Ozawa, U. S. Nat. Mus., Proc., vol. 77, Art. 6, 1930, p. 73, pl. 18, figs. 2-4.

Description.—Test ovate, slightly compressed, tapering from a rounded base to the aperture at the apex; three chambers visible, inflated, overlapping, nearly tri-serial in arrangement; sutures distinct, depressed; wall smooth, translucent, apertures of early chambers clearly discernable, final aperture terminal and radiate. Length of illustrated specimen, 0.2 mm.

Remarks.—Specimens assigned to this species vary

in minor characteristics from some of the figured tests, but in the fundamental arrangement of chambers they correspond closely to the type.

Occurrence.—*G. inaequalis* occurs frequently in the middle and lower beds of the Ripley in central and western Alabama. The illustrated specimen is from Rocky Bluff (Locality No. 105).

Genus GLANDULINA d'Orbigny
Glandulina laevigata d'Orbigny
Plate XXXII, Fig. 15.

"*Cornu Hammonis erectum globosius*" Plancus, Conch. Min. 1739, p. 16, pl. 13, fig. 1.

Nodosaria (Glandulina) laevigata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 252, pl. 10, figs. 1-3; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 490, pl. 61, figs. 20-22; Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 308, pl. 55, fig. 3; Bagg, Roc. U. S. Nat. Mus., vol. 34, 1908, p. 143; Cushman, U. S. Nat. Mus., Bull., No. 100, vol. 4, 1921, p. 185, pl. 33, fig. 1; U. S. Nat. Mus., Bull. No. 104, pt. 4, 1923, p. 64; U. S. Nat. Mus., Bull. No. 71, pt. 3, 1931, p. 47, pl. 24, figs. 1, 2; Chapman, New Zealand Geol. Surv. Pal. Bull. No. 11, p. 46, pl. 3, figs. 6-9; pl. 10, fig. 14.

Glandulina laevigata d'Orbigny, Foram. Foss. Boss. Tert. Vienne, 1846, p. 29, pl. 1, figs. 45; Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II., vol. 21, 1893, p. 336, pl. 11, fig. 31; Cushman, Cont. Cushman. Lab. Foram. Research, vol. 3, pt. 1, 1927, p. 45, pl. 9, fig. 8.

Description.—Test fusiform, broad in the middle, tapering at either end, apical end sharply pointed, sometimes with a spine, symmetrical; chambers few, embracing, increasing in diameter as added; last one making up a half or more of the length of the test; sutures marked by a fine line, flush with the surface; wall smooth, often retaining its polish; aperture terminal, rounded, radiate, with lines extending a short distance down the wall of the test. Length 0.5 mm.

Remarks.—Specimens of this species have been obtained from the Ripley formation which correspond almost identically with the original figures of d'Orbigny as given in the *Annales des Sciences Naturelles*. They also are very close to the recent forms figured by Brady and

Cushman. Some specimens considerably longer than the types may constitute a variety, but the evidence for this is not conclusive, and for the present they are included with the typical *G. laevigata* species.

Occurrence.—Tertiary strata are known to bear this form abundantly over practically the entire world, and it ranges from the Lias to the present. Cretaceous occurrences are common in Europe. The species occurs rarely in the lower and upper beds of the Ripley formation of the Alabama river section. The figured specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Family HETEROHELICIDAE

Genus GUEMBELINA Egger

Guembelina globulosa (Ehrenberg)

Plate XXXII, Figs. 10, 11.

Textilaria globulosa Ehrenberg, Abh. Preuss. Akad. Wiss., 1838, p. 135, pl. 4, fig. B; Reuss, Verstein. bohm. Kreidet., 1845-46, p. 39, pl. 12, fig. 23.

Guembelina globulosa Chapman, New Zealand Geol. Surv. Pal., Bull. No. 11, 1926, p. 33, pl. 8, fig. 6; Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 43, pl. 7, figs. 3-5.

Description.—Test short, laterally compressed, broad and inflated at the apertural end, tapering uniformly but rather abruptly to a sharply pointed apical end; chambers biserial, globular, in early stages very small and compactly spaced, later increasing rapidly in size and becoming much inflated; sutures distinct, impressed, deep between the later chambers; wall thin, surface covered with very fine, longitudinal striae; aperture an elongated, arched opening at the base and inner margin of the last formed chamber. Length of illustrated specimen, 0.4 mm.

Remarks.—The figures of this species given by Reuss and Chapman do not show striation of the surface, but Chapman lists ornamented and unornamented representatives so that some of his specimens may have displayed this characteristic. Reuss' very small figure is conventionalized and safely may be assumed to have been ornamented in

some cases. These Ripley forms correspond very closely to the figured European specimens in all other respects. *G. globulosa* has been reported from the Upper Cretaceous of Europe by many authors, and also has been found in North America, Australia, and New Zealand in rocks of this age. Chapman regards it as typical of the Upper Cretaceous in Europe and North America.

Occurrence.—The illustrated specimen is from Sandy Ridge (Locality No. 4).

Genus VENTILABRELLA Cushman

Ventilabrella carseyae Plummer

Plate XXXI, Fig. 29.

Textularia globulosa Carsey, Univ. of Texas, Bull., 2612, 1926, p. 25, pl. 5, figs. 2a, b.

Ventilabrella carseyae Plummer, Univ. of Texas, Bull. 3101, 1931, p. 178, pl. 9, figs. 7-10.

Description.—Test short, stout, initial portion pyramidal in shape, tapering to a sharp apex, sometimes twisted, apertural end highly arched, rounded; chambers at the apical end very small, compact, biserial, increasing in size as added and becoming inflated, final chamber large and oval-shaped, resting transversely in the depression between the last pair of biserial chambers; sutures in early stages visible as fine, dark lines, later becoming impressed, distinct; wall calcareous, ornamented with fine striations extending longitudinally over the surface of the chambers; aperture an elongate, arched slit on either side of the base of the last-formed chamber. Length of illustrated specimen, 0.31 mm.

Remarks.—This well preserved and striking representative of Cushman's genus corresponds quite closely to the Cretaceous species *Guembelina polystropha* (Reuss), but may be distinguished from that form by its striated surface and stouter build. The Ripley species are also less twisted than the European forms. Carsey's specimens are from the Lower Cretaceous of Texas, and Plummer reports the species from the Navarro formation.

Occurrence.—*V. carseyae* has been found in the lower and upper beds of the Ripley in the central part of the State. It probably ranges through the middle strata of this section, but this is not definitely known at present. The occurrence at the horizons mentioned is rare. The figured specimen is from Sandy Ridge (Locality No. 4).

Family BULIMINIDAE

Genus LOXOSTOMA Ehrenberg

Loxostoma plaitum (Carsey)

Plate XXXI, Fig. 22.

Bolivina plaita Carsey, Univ. of Texas, Bull., No. 2612, 1926, p. 26, pl. 4, fig. 2.

Proroporus plaita Cushman, Cont. Cush. Lab., vol. 2, 1927, p. 89, pl. 12, fig. 7a, b.

Loxostomum plaitum (Carsey) Cushman, Cus. Lab. Foram. Res., Spec. Pub. No. 1, 1928, pl. 37, fig. 9; Tenn. Geol. Surv., Bul. No. 41, 1931, p. 51, pl. 8, fig. 9; Jour. Pal., vol. 5, 1931, p. 310, pl. 35, figs. 16a, b.

Loxostoma plaitum Plummer, Univ. of Texas, Bull. No. 3101, 1931, p. 182, pl. 10, figs. 5-7.

Description.—Test elongate, laterally compressed, tapering, initial end rounded; oral end blunt, subcylindrical in horizontal section, formed by a single elongated chamber; general appearance is "plaited"; chambers numerous, somewhat inflated, outer portions drooping downward along narrow edge of test, arranged biserially; sutures impressed, hyaline, clearly visible, extending obliquely downward to either side of shell; wall hyaline, sometimes iron stained, smooth, finely punctate; aperture an elongate slit extending across apex of last chamber in plane of compression and inclined downward toward last preceding chamber. Length of illustrated specimen, 0.6 mm.

Remarks.—The species is very close to *Bolivina punctata* d'Orbigny and to *B. porrecta* Brady. In fact it might well be considered as intermediate between these two forms. *L. plaitum* is very abundant in the Lower and Middle Ripley. Carsey reports its abundant occurrence in the Navarro of Texas, as also does Plummer. Thus far it has not been reported from strata other than Upper Cretaceous.

Occurrence.—The illustrated specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Family ROTALLIDAE

Genus ROTALIA Lamarck

Rotalia aequilateralis Plummer

Plate XXXIII, Figs. 3, 4.

Rotalia aequilateralis Plummer, Univ. of Texas, Bull. 2644, p. 155, pl. 12, figs. 3a-c.

Description.—"Test almost equally biconvex, composed of about two and one-half convolutions that increase very slowly in width; peripheral margin narrowly rounded, faintly lobate in the last-formed portion of the test; dorsal sutures distinct, narrow, tapering bands without elevation, strongly curved, with a slight angulation, but not oblique, ventral elevated most markedly around the small umbilicus and tapering radially toward the margin, dark on tests filled with mineral matter; aperture a very narrow slit at base of septal face and bearing a very narrow extended lip." The diameter of the illustrated specimen from the Ripley is 0.3 mm.

Remarks.—Ripley specimens of the species correspond closely to the figures and the original description of Plummer given above. The only observed difference is that the ventral sutures are not limbate around the umbilicus, as is the case with the Midway form. Plummer found representatives in both the Midway and the Navarro of Texas so that the form has no stratigraphic value.

Occurrence.—The illustrated specimen is from Red Bluff (Locality No. 105).

Rotalia cretacea Carsey

Plate XXXIII, Figs. 7, 8.

Rotalia cretacea Carsey, Univ. of Texas, Bull. 2612, 1926, p. 48, pl. 5, figs. 1a, b.

Description.—Test round, biconvex, dorsal side low, ventral face highly convex, periphery rounded, lobate

in the later stages; chambers numerous, 11 or 12 in the last whorl, later ones slightly inflated; sutures on dorsal side short and gently curved, impressed between later chambers, on ventral side slightly curved and radiating from the center; umbilicus small, sometimes occupied by a node of shell material; wall smooth, finely punctate; aperture a narrow, elongate slit at the ventral margin of the last chamber and extending from the periphery to the umbilicus. Diameter 0.35 mm.

Remarks.—This species was originally discovered in the Upper Cretaceous of Texas, where it is common in the Navarro formation and occurs more sparingly in the lower strata. *Rotalia aequilateralis* is a closely related form from the same fauna. The two differ principally in size and degree of convexity. *R. cretacea* is much the larger and more convex form. Both species occur in the Ripley fauna.

Occurrence.—*R. cretacea* at present is known only from the upper beds of the Ripley formation at Prairie Bluff (Locality No. 87), on the Alabama river.

Family CHILOSTOMELLIDAE

Genus PULLENIA Parker and Jones

Pullenia quinqueloba (Reuss)

Plates XXXIII, Figs. 1, 2.

Nonionina quinqueloba Reuss, Zeit. deutsch. geol. Gessel., 1851, vol. 3, p. 47, pl. 5, fig. 31.

Pullenia quinqueloba Cushman, U. S. Nat. Mus., Bull. No. 104, pt. 5, 1924, p. 42, pl. 8, figs. 5-9, 11; Plummer, Univ. Tex., Bull. 2644, 1926, p. 136, pl. 8, figs. 12a, b.

Description.—Test plano-spiral, biconvex, bilaterally symmetrical, periphery somewhat compressed but rounded; chambers few, usually five in the last whorl, completely embracing; sutures slightly impressed, especially between the last few chambers, radial; wall smooth, aperture an elongate, slightly arched slit following the contour of the lower margin of the last chamber. Diameter of illustrated specimen, 0.45 mm.

Remarks.—The chief distinguishing characteristics of this species are the five chambers in the last whorl, its biserial symmetry, and the slight lateral compression of the test. The only similar species is *P. sphaeroides* d'Orbigny which has only four chambers and is nearly spherical in shape, and *P. quarternaria* (Reuss), which has five chambers, but is not compressed.

Occurrence.—*P. quinqueloba* is common in the Cretaceous and Tertiary of Europe, but in the Eocene and Cretaceous of Texas it is rare. Recent forms have been found in the Atlantic, the Caribbean, the Gulf of Mexico, and in the Pacific. They are usually inhabitants of deep, cold water. This species is very rare in the Ripley, and has been discovered only in the exposure at the mouth of Boguechitto Creek (Locality No. 106).

Family GLOBIGERINIDAE

Genus GLOBIGERINA d'Orbigny

Globigerina cretacea d'Orbigny

Plate XXXIII, Figs. 13, 14, 15.

Globigerina cretacea d'Orbigny, Mem. Soc. geol. France, ser. 1, vol. 4, 1840, p. 34, pl. 3, figs. 12-14; Reuss, Verst. bohm. Kreidef., pt. 1, 1845, p. 36, pl. 8, figs. 55a, b; Chapman, New Zealand Geol. Surv., Pal. Bull. No. 11, 1926, p. 72, pl. 14, fig. 14; Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 58, pl. 10, figs. 6, 7.

Description.—Test rotaliform, compressed, upper face flattened, inferior face concave, umbilicus open, chambers numerous, five to seven in last whorl, inflated, globular, forming about three convolutions, all chambers visible from above, only the last whorl from below; autures impressed and distinct; wall thin, punctate, covered with fine spines; apertures multiple, opening into the umbilical cavity. Diameter of illustrated specimen, 0.35 mm.

Remarks.—This species resembles very closely *G. dubia* Egger, and frequently has been confused with that form. It differs from Egger's species in being more compressed and outspread, and in not attaining as great size.

There also is some resemblance to *G. bulloides*, but this form is much more trochoid and has its chambers less regularly arranged.

G. cretacea is said by Brady to be the most widely diffused and the commonest of all the Cretaceous microzoa, a statement which is borne out by a survey of the literature. The synonymy is quite large, and only a few representative citations are here presented.

Occurrence.—This species occurs abundantly in the Ripley formation, but, so far as is now known, it is confined to the lower beds. A single station in the lower-middle strata has yielded specimens which are very small and emaciated, indicating a probable change in environment with the subsequent dying out of the species. This should make the form a useful guide fossil. The figured specimen is from the mouth of Boguechitto Creek (Locality No. 106).

Globigerina rugosa Plummer

Plate XXXIII, Figs. 11, 12.

Globigerina rugosa Plummer, Univ. of Texas, Bull. 2644, p. 38, pl. 2, figs. 10a-d.

Description.—Test rotaliform, close-coiled, superior side flattened or only slightly convex, inferior side convex; chambers globular, much inflated on ventral side, increasing in size rapidly as added, last four or five chambers making up most of the test; wall rather thick, surface covered with short, stout spines, rough; aperture multiple, opening into the umbilical cavity which is covered with an irregularly shaped septum of thin shell material having several openings around the edges. Diameter of illustrated specimen, 0.3 mm.

Remarks.—There are few species of *Globigerina* possessing the peculiar apertural features characteristic of *G. rugosa*, and these together with the rough, globular chambers, and the protective plate over the umbilical cavity, make determination of the form quite difficult.

Occurrence.—This species was found by Plummer in the Navarro formation of Texas where it occurs rarely

through the upper strata. The Ripley formation carries the form rather abundantly in the middle and upper beds, and rarely in the lower strata. The illustrated specimen is from Rocky Bluff (Locality No. 88).

Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny

Anomalina complanata Reuss

Plate XXXI, Fig. 30, 31.

Anomalina complanata Reuss, Haidinger's Nat. Abh., vol. 4, 1851, p. 20, pl. 3, fig. 3; Frauke, Preuss. Geol. Laudes., vol. 3, 1928, p. 180, pl. 16, figs. 2a, b; Cushman, Tenn. Geol. Surv., Bull. 41, 1931, p. 60, pl. 11, figs. 7a, c.

Description.—Test involute, compressed, equally biconvex, peripheral margin subacute, rounded; chambers numerous, rather narrow, very slightly curving, last few somewhat inflated; sutures in early part of test limbate, terminating at the edge of the umbilical area in small irregular masses of shell material, a small umbo sometimes present on the dorsal side, sutures in later stages impressed, distinct, wall coarsely punctate; aperture an arched opening at the base of the last chamber and on the periphery, extending toward the umbilicus. Diameter of illustrated specimen, 0.45 mm.

Remarks.—Specimens from the Ripley formation have been referred to this species correspond closely to the average form figured in the literature. These show considerable variation, however, and it may easily be possible on further study to establish several varieties of the species in the Ripley fauna.

Occurrence.—*A. complanata* ranges geologically from early Cretaceous to the present, and is especially abundant in the Cretaceous and Tertiary formations. Its distribution is world-wide. Living forms occur in both shallow and deep water. The species occurs abundantly throughout the Ripley formation in Alabama. The illustrated specimen is from the mouth of the Boguechitto Creek (Locality No. 106).

Anomalina grosserugosa (Gümbel)

Plate XXXIII, Figs. 9, 10.

Truncatulina grosserugosa Gümbel, Abh. kön. bay. Akad. Wiss., Cl. II., vol. 10, p. 660, pl. 2, fig. 104.

Anomalina grosserugosa (Gümbel) Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 673, pl. 44, fig. 4, 5; Bagg, U. S. Nat. Mus., Bull. No. 88, 1898, p. 67, pl. 6, fig. 4; Cushman, U. S. Nat. Mus., Bull. No. 71, pt. 5, 1915, p. 45, pl. 20, fig. 1; Plummer, Univ. Tex., Plummer, Bull. 3101, 1931, p. 201, pl. 14, fig. 9.

Description.—Test nautiloid, dorsal side flattened or slightly concave, ventral side strongly convex, periphery broadly rounded, slightly lobate; chambers numerous, 8 to 9 in the last whorl, all visible from dorsal side, only those of the last coil on the ventral side inflated, increasing in size gradually as added; sutures in early part of test somewhat limbate especially near the center, later impressed; wall coarsely perforate; umbilical cavity filled by a circular mass of shell material, a very small umbo sometimes present on the ventral side; aperture an elongate, arched slit on the base of the last chamber.

Remarks.—The specimens of this species from the Ripley correspond closely to the *Challenger* figures, but are somewhat more inflated than Gümbel's original drawings indicate. They are practically identical with Chapman's figures of specimens from the Tertiary of New Zealand. Plummer has found this form in the Navarro formation of Texas. The species has a long geologic range, having been reported from the Neocomian of England and occurring in subsequent formations up to the present. Recent species have been found in the Pacific.

Occurrence.—*A. grosserugosa* occurs abundantly in the lower Ripley of central Alabama, and has been found in the Upper beds of the Alabama River section. The figured specimen is from the mouth of the Boguechitto Creek (Locality No. 106).

Genus CIBICIDES Montfort
Cibicides wuellerstorfi (Schwager)

Plate XXXIII, Figs. 5, 6.

Anomalina wuellerstorfi Schwager, Novara Exped., geol. Teil., vol 2, 1886, p. 258, pl. 7, figs. 105, 107.

Truncatulina wuellerstorfi Cushman, U. S. Nat. Mus., Bull. 71, pt. 5, 1915, p. 34, pl. 12, fig. 3; U. S. Nat. Mus., Bull. No. 100, vol. 4, 1921, p. 314, pl. 64, figs. 1a-c; Chapman, New Zealand Geol. Surv., Pal. Bull. No. 11, 1926, p. 79, pl. 16, fig. 3.

Description.—Test oval, biconvex, somewhat compressed, periphery acute, bordered by a narrow rim of clear shell material; slightly lobate in the later stages; chambers numerous, 9 to 10 in the last whorl, elongate, narrow, curved, increasing in size gradually as added; sutures smooth or slightly impressed on the ventral side, somewhat limbate on the dorsal side, the inner ends fusing and forming a spiral in the umbilical area; wall coarsely punctate; aperture a low arched slit extending from the ventral side across the periphery and deep into the dorsal side under the lower edges of the chambers. Diameter of illustrated specimen, 0.32 mm.

Remarks.—Specimens of this species from the Ripley formation correspond closely to the figures of Brady in the *Challenger* report, and to those in the report on the Philippine foraminifera, which represents specimens of marked convexity and moderately large chambers.

Occurrence.—*C. wuellerstorfi* ranges geologically from the Neocomian of Europe to the present. It is especially abundant in the Tertiary. Recent forms are usually found in deep water. The Ripley carries this species rarely in the lower strata of the Alabama River section. The illustrated specimen is from the mouth of the Boguechitto Creek (Locality No. 106).

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PLATE XXXI.

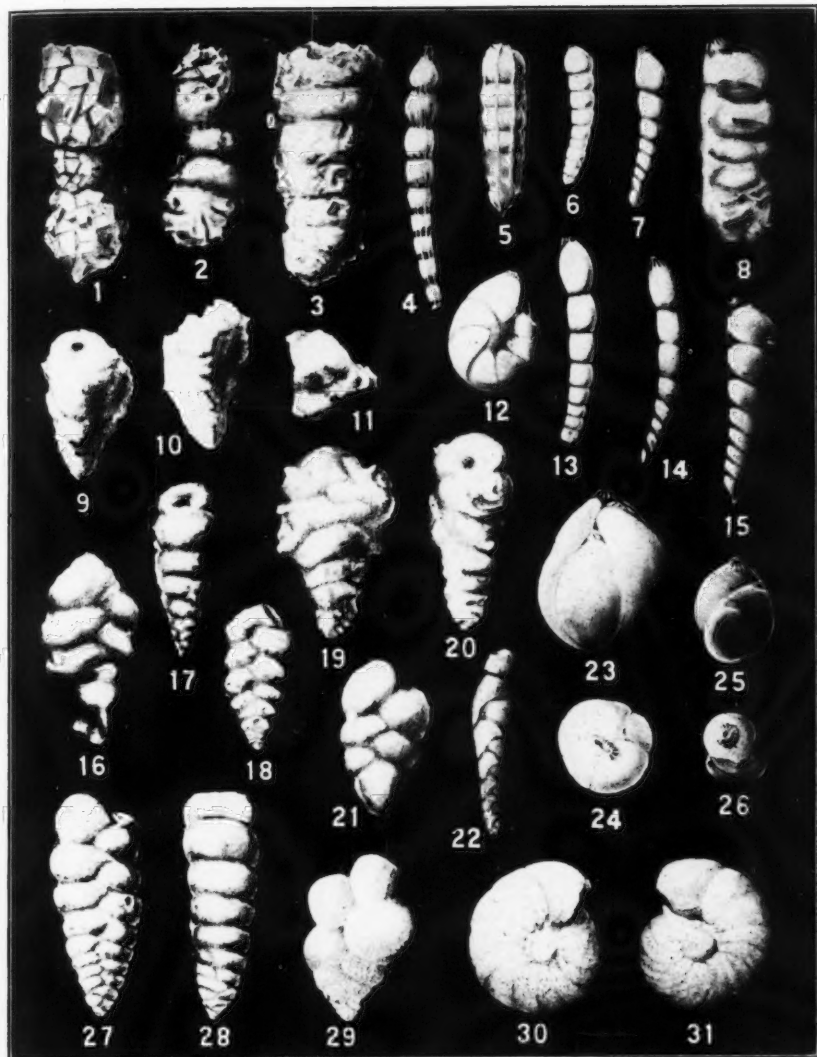


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PLATE XXXII.

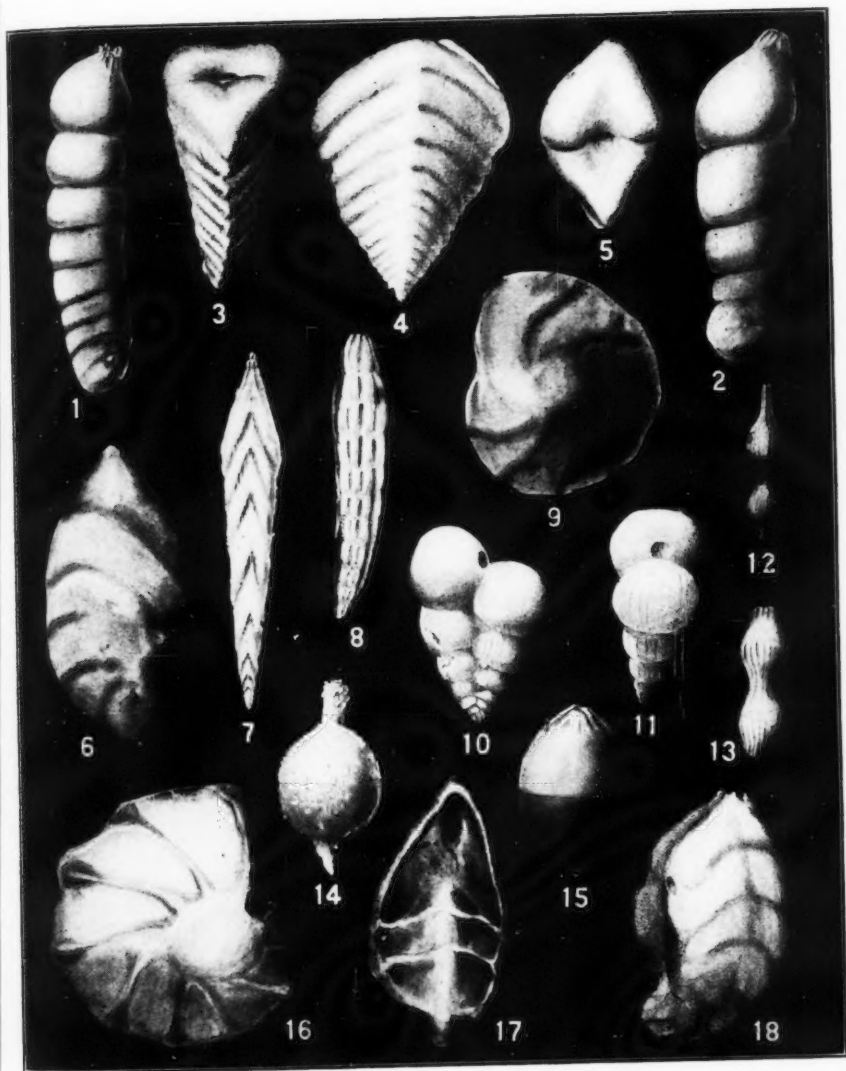
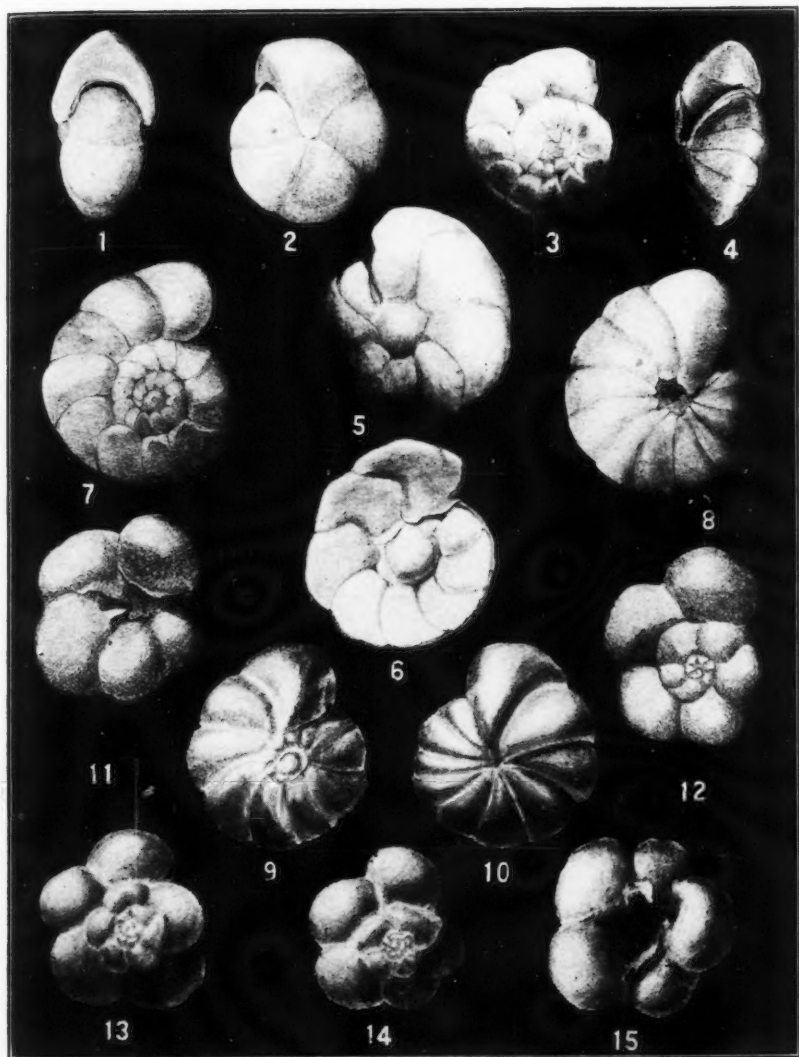


PLATE XXXIII.

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PLATE XXXIII.



A STUDY OF THE OSTRACODE FAUNA OF THE AR- ROYO FORMATION, CLEARFORK GROUP OF THE PERMIAN IN TOM GREEN COUNTY, TEXAS

H. N. CORYELL AND HENRY ROGATZ

INTRODUCTION

The Ostracodes described in this paper give evidence of having belonged to an indigenous and secluded fauna. In this respect the presence of the new genus *Knoxina* is significant. This form seems to have evolved from the genus *Jonesina*, and, although four species of *Knoxina* are already described below, others could probably be included were it not for the poor preservation of the carapaces, making identification too uncertain.

The time required must have been fairly great to have produced the appreciable divergence of structure in species from the simplest to the most complicated of the genus *Knoxina*. The coexistence of such a series of animals tends to suggest a forced seclusion of long duration. Adding even more weight to this conclusion is the presence of such a few genera (six) and species (ten) in a formation which is so replete with Ostracode individuals that the including rock can really be termed an Ostracode ooze. It is not uncommon to find at least twice as many genera and species in a formation which has but a comparatively few individuals. This condition would seem likely to exist only where barriers have kept out migrating faunas.

It does not seem plausible that the environmental conditions would be sufficiently agreeable to permit the creation of so densely a populated colony as existed in this area and yet would be unable to support newcomers. Some condition must have existed which served to keep out immigrating faunas for a period sufficiently long for an indigenous fauna to have developed.

As final evidence of the provincialism of this fauna is the presence, side by side, of the genus *Paraparchites* and of a form *Antiparaparchites*, which possesses similar characters in the reverse order. There are several species of both genera represented in our material, but only one form of each genus is presented here. Much time must have been required to produce a new genus with so many possible species.

That this fauna might be provincial is important. We know that the Permian basin in Wichita time was already being cut off from the sea. We know, also, that large amounts of red muds and silts were being deposited at intervals along the shoreline of the basin. This means that deltas were pushing their way basinward; that the basin was rapidly being filled up while local barriers were forming. The salinity of the water must have, of necessity, varied extensively over comparatively short distances, especially around the margins of the basin. Species which had finally acclimated themselves to the salinity of their particular area and general environment might have found it difficult and even impossible to exist in areas of different salinity or turbidity.

The possibility of the presence in the later stages of the Permian Basin of faunas which are too provincial may prove to be a great handicap in the correlating of Permian formations.

The reader's attention is called to the extended range of the genus *Cavellina*, which was previously restricted to the Pennsylvanian.

LOCALITY

The material containing the Ostracodes described herein was collected by Richard E. Gile during the latter part of 1930. It is from the outcrop of the Arroyo member, which bottoms the Clearfork group, in Tom Green County, along the Concho River, four miles east of the highway and four miles south of the town of Miles (Runnels Co.). The sample was taken at the foot of the canyon, 100 feet below the surface.

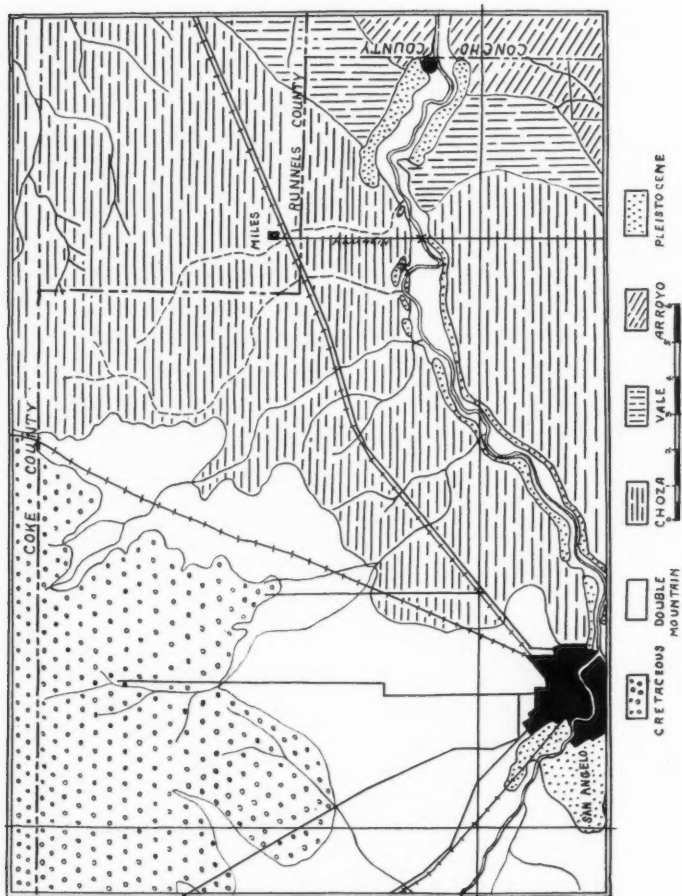
STRATIGRAPHY

The arroyo formation in Tom Green County forms the base of the Clearfork group of the Permian, (table 1). In the locality of the station from which the collection of material was made, this formation consists of interbedded and inter-fingered yellow shales and gray limestones, quite fossiliferous throughout. The thickness at this station is about 250 feet and the beds dip in a northwesterly direction. At the sample station the surface rock is of the Choza formation which outcrops at the top of the canyon of the Concho River. This serves to cover up the Arroyo, Vale and Bullwagon formations. The Arroyo appears 100 feet below at the base of the canyon wall.

TABLE I.

P E R M I A N	CRETACEOUS	
	DOUBLE MOUNTAIN	BLAINE
		SAN ANGELO
	CLEAR FORK	CHOZA
		BULLWAGON
		VALE
	WICHITA ALBANY	ARROYO
		LEUDERS
		CLYDE
		BELLE PLAINS
		ADMIRAL
	PENN	

----- UNCONFORMITY



Map of a portion of Tom Greene County, Texas showing the collecting locality (marked O).

CLASSIFICATION AND DESCRIPTION OF
GENERA AND SPECIES

Family KLOEDENELLIDAE Ulrich & Bassler 1923

Genus **Knoxina** Coryell and Rogatz n. gen.Genotype—*Knoxina lecta* Coryell and Rogatz n. sp.

Description: Small, inequivalved, subquadrangular carapace; hingeline straight; left valve overlaps the right on all sides except on dorsal margin, overlaps greatest along ventral border; surface finely granulose, marked with a deep sulcus in the dorsal half located somewhat behind the middle, and an indistinct sulcus in the dorso-posterior area, the two being separated by a broadly swelling node; a more or less important costa approximately parallels the ventral border; at the dorsal border, and almost paralleling it, may be one or more sharp costae usually en echelon, when two or more are present; dorsal view either elliptical or wedge-shaped.

This genus differs from *Jonesina* in that it has one or more costae, and from *Glyptopleura* in that it has a sulcus.

To this genus is added *Jonesina texana* Harlton, Bureau Econ. Geol. Bull. 2901, p. 146, pl. 1. fig. 14 a, b.

This genus is named for J. K. Knox.

Knoxina lecta Coryell and Rogatz n. sp.

Plate XXXIV, Figs. 1-3.

Description: Small, inequivalvel, subquadrangular carapace; hingeline straight; anterior margin broadly rounded; posterior margin slightly convex toward dorsal region but broadly rounded toward center; ventral margin broadly convex; left valve overlaps the right along the free margin; greatest overlap along the ventral border; each cardinal extremity denticulate with an external tooth of right valve over left; surface finely granulose; a deep sulcus is situated in the posterior half just behind the middle of the carapace; a broadly rounded swelling separates this sulcus from a less

distinct sulcus near the posterior border; anterior half broadly rounded; the convexity of each valve increases from the posterior margin toward the anterior margin where it slopes downward very steeply to the anterior and ventral borders; carapace is therefore thickest anteriorly, giving a wedge-shaped dorsal aspect; on the ventral crest of this steep descent is a sharp costa which parallels the ventral margin, curving around anteriorly and disappearing about midway along the anterior crest; on the left valve, the steep slope ends in a very narrow platform along the central portion of the ventral border; dorsal margin of the left valve is bordered by two sharp costae arranged en echelon, tending obliquely posteriorly; the posterior-most costa is closer to the dorsal edge and evanesces into the rear margin of the posterior sulcus; the right valve bears only the anterior costa along the dorsal border; cardinal angles broadly obtuse; length, 0.8 mm.; height, 0.51 mm.; width, 0.4 mm.

Holotype, Columbia University Paleo., Coll., No. 27513.

***Knoxina elliptica* Coryell and Rogatz n. sp.**

Plate XXXIV, Figs. 4-6.

Description: Small, inequivalved, subquadrangular carapace; hingeline straight; anterior margin broadly rounded with a gentle backward swing along the anterior-ventral portion; dorsal-posterior margin almost straight, grading into convex curve along ventral-posterior; ventral border broadly convex; left valve overlaps the right along free margin; greatest overlap on ventral border; cardinal extremities denticulate with external tooth of right valve over left; surface finely granulose; a well-defined sulcus is situated in posterior half just behind the middle of the carapace; a broadly rounded swelling separates this sulcus from a less distinct one near the posterior border; the anterior half is broadly rounded; an indistinct costa approximately parallels the antero-ventral margin about one-third the height from the venter; on right valve a steep, almost vertical slope extends from the costa to ventral border, and grades into gentle slopes along both posterior and anterior portions; on left valve the ridge is even

more indistinct, the slope to the ventral being much more gentle and terminating in a narrow platform; dorsal margin of the left valve bordered by two sharp costae arranged en echelon, trending obliquely posteriorly; posterior costa is closer to the dorsal edge and disappears into the rear margin of the posterior sulcus; the right valve bears only the anterior costa along the dorsal border; cardinal angles obtuse.

Length, 0.75 mm.; height, 0.47 mm.; width, 0.3 mm.

Holotype, Columbia University Paleo., Coll., No. 27514.

Knoxina elliptica is distinct from *Knoxina lecta* in having the greatest width at sulci, producing an elliptical dorsal view; *Knoxina lecta* has the greatest width near the anterior border, which produces a wedge-shaped dorsal aspect. Also, the ventral costa is much shorter and does not extend around to the anterior.

***Knoxina incurvata* Coryell and Rogatz n. sp.**

Plate XXXIV, Figs. 7-9.

Description: Small, inequivalved, subquadrangular carapace; hingeline straight; anterior margin very broadly rounded, meeting ventral margin in a backward slope which extends to posterior venter; posterior-dorsal slope straight, forming medium obtuse cardinal angle; left valve overlaps the right along free margin, greatest overlap along the ventral border; surface finely granulose; a deep sulcus is situated in the posterior half just behind the middle of the carapace; a broadly rounded swelling separates this sulcus from a less distinct one near the posterior border; midway between sulcus and venter of carapace is a very prominent evanescent costa which parallels the ventral margin; surface of the valves slopes steeply from the costa toward the sulcus and almost vertically toward ventral margin in dorsal view; short costa present in each valve along the dorsal margin of a broad swelling in the anterior half; length, 0.65 mm.; height, 0.38 mm.; width, 0.33 mm.

Holotype, Columbia University Paleo., Coll., No. 27516.

Distinct from *Knoxina lecta* and *Knoxina elliptica* in that the dorsal view of *Knoxina incurvata* resembles an arrow-head, having appearance of wing-like projections at median area. This species differs further in that it has only the anterior costae present and they are shorter; the anterior-ventral border has a backward swing.

***Knoxina indistincta* Coryell and Rogatz n. sp.**

Plate XXXIV, Figs. 10-12.

Description: Small, inequivalved, subquadrangular carapace; hingeline straight; anterior margin very slightly convex and almost perpendicular to dorsal; meets venter in long, well-inclined, backward swing, extending to within one-third length from posterior; greatest height in posterior third; dorso-posterior almost straight, grading into broad convex curve along ventral-posterior; cardinal angles obtuse; left valve overlaps the right along free margin; greatest overlap on ventral border; surface finely granulose; a shallow sulcus is situated in the posterior half just behind the middle of the carapace; a broadly rounded swelling separates the sulcus from a less distinct sulcus near the posterior border; midway between sulcus and ventral margin is a faint, evanescent costa which parallels the ventral margin of carapace; surface slopes gently from the ventral costa toward the sulcus and almost vertically toward the ventral margin; a low swelling lies in anterior-dorsal quarter; length, 0.64 mm.; height, 0.38 mm.; width, 0.28 mm.

Holotype, Columbia University Paleo., Coll., No. 27515.

This species differs from *Knoxina incurvata* in that the former has no dorsal costae and those on the ventral border are indistinct. Further, the dorsal view is more elliptical; arrowhead appearance not as prominent as in *Knoxina incurvata*.

Family LEPERDITELLIDAE Ulrich & Bassler, 1906

Genus PARAPARCHITES Ulrich & Bassler, 1906

Genotype *Paraparchites humerosus* Ulrich & Proc.

U. S. Nat. Mus., vol. 30, p. 149, pl. 11, figs. 1-4, 1906.

Paraparchites oviformis Coryell and Rogatz n. sp.

Plate XXXV, Figs. 1, 2.

Description: Small, inequivalved, leperditoid carapace; hingeline straight and short, more than half length of shell; dorsal margin slightly arched on left valve and nearly straight on the right valve; anterior broadly rounded, meeting the ventral border with an oblique backward swing which continues along the ventral border to about two-thirds of the distance to posterior; latter also broadly rounded, but meeting ventral border more sharply; greatest height about two-fifths from posterior end; right valve is rabbeted along ventral border to receive the left valve, overlapping the latter along the border; dorsal edges of valves unequal, the left slightly the more prominent; surface smooth, greatest thickness in dorsal half, slightly anterior of the center; convexity slopes rather gently in all directions but most steeply towards dorsal margin; anterior cardinal angle obtusely rounded; posterior cardinal angle more obtusely angulated; length, 0.95 mm.; height, 0.67 mm.; width, 0.45 mm.

Holotype, Columbia University Paleo., Coll., No. 27521.

The ventral and dorsal margins are less arcuate and the carapace more elongated in the mature forms, the ventral margin being nearly straight in the gerontic forms.

Genus **Antiparaparchites** Coryell and Rogatz n. genGenotype *Antiparaparchites reversus* Coryell and

Plate XXXV, Figs. 3, 4.

Description: Small, inequivalved, leperditoid carapace; hinge-line straight to slightly convex; dorsal margin slightly arched in right valve and nearly straight in left valve; anterior broadly rounded, meeting the ventral border with an oblique backward swing; posterior margin more broadly rounded dorsally than ventrally, meeting the ventral border with quite a regular curvature; greatest height in posterior half; left valve is rabbeted along ventral border to receive the

right valve, overlapping the latter along that border; dorsal edges of valves usually unequal, the right slightly the more prominent and may either overlap or receive the edges of the left valve; surface smooth; greatest thickness in dorsal half slightly above the middle of the valve; convexity slopes regularly, somewhat more steeply along the dorsal margin; anterior and posterior cardinal angles broadly obtuse.

Antiparaparchites differs from *Paraparchites* in the reversal of orientation of carapace; left valve overlaps right along free border of *Antiparaparchites*; reversed in *Paraparchites*.

***Antiparaparchites reversus* Coryell and Rogatz n. sp.**

Plate XXXV, Figs. 3, 4.

Description: Small, inequivalved, leperditoid carapace; hingeline straight, more than half length of shell; dorsal margin slightly arched on right valve; anterior broadly rounded, meeting the ventral border to about two-thirds distance to posterior; latter also broadly rounded, but meeting ventral border more sharply; greatest height about two-fifth from posterior end; left valve is rabbeted along ventral border to receive the right valve, overlapping the latter along the border; dorsal edges of valves unequal, the right the more prominent; surface smooth, greatest thickness in dorsal half, slightly anterior of center, sloping rather gently in all directions, but most steeply to dorsal margin; anterior cardinal angle rounded, slightly obtuse; posterior cardinal angle more obtusely angulated; length, 1.17 mm.; height, 0.88 mm.; width, 0.5 mm.

Holotype, Columbia University Paleo., Coll., No. 27520.

This species is the opposite of *Paraparchites*, having the left valve overlapping the right along the free margin, and the right valve slightly the more prominent along the dorsal margin instead of the left as in *Paraparchites*.

Family CYTHERELLIDAE Sars 1865

Genus CAVELLINA Coryell 1928

Cavellina arcuata Coryell and Rogatz n. sp.

Plate XXXV, Fig. 5.

Description: Small, subreniform, inequivalved carapace; dorsal margin arcuate, greatest height immediately posterior of center; posterior-dorsal edge broadly rounded; posterior-ventral truncated; posterior and posterior-ventral contact depressed, giving well-rounded, overhanging appearance to margin of left valve; anterior margin broadly rounded; ventral contact straight or very slightly concave; ventral profile wedge-shaped, being thickest at one-fifth the length of shell from posterior edge; right valve much larger than the left, projecting broadly beyond the edge of the left valve on the dorsal and ventral margins, one-half as much on the posterior and very slightly on anterior; the internal ridge lies about one-third length of shell from posterior end; length, 0.9 mm.; height, 0.56 mm.; width, 0.37 mm.

Holotype, Columbia University Paleo., Coll., No. 27517.

Genus CYTHERELLA Jones, 1849

Cytherella molaris Coryell and Rogatz n. sp.

Plate XXXV, Fig. 6.

Description: Small, gibbous, inequivalved, elongated, cytherelloid carapace; dorsal margin arcuate; posterior-dorsal gently convex, sharply meeting the posterior which is very broadly rounded; posterior venter truncated; ventral margin slightly concave; anterior very broadly rounded; right valve overlaps left entirely but does not show along posterior venter as seen in lateral view; overlap is broad along dorsal and ventral, about half as much on the anterior and very narrow on the posterior; dorsal contact broadly undulating due to change in width of overlap; ventral contact very nearly

straight; length, 0.92 mm.; height, 0.52 mm.; width, 0.33 mm.

Holotype, Columbia University Paleo. Coll. No. 27522.

Family CYTHERIDAE Zenker 1854

Genus **Ellipsella** Coryell and Rogatz n. gen.

Genotype *Ellipsella obliqua* Rogatz n. sp.

Description: Carapace small, smooth, subquadrangular; right valve larger, producing hingement which overlaps the left valve at the posterior cardinal angle and anterior dorsal slope, forming dentitions at these points; hingeline either straight or undulating as seen in dorsal view; dorsal margin slightly convex; posterior and anterior margin broadly rounded; ventral border convex.

Ellipsella obliqua Coryell and Rogatz n. sp.

Plate XXXV, Figs. 7, 8.

Description: Carapace small, smooth, subquadrate; right valve larger, overlapping along dorsal margin at the posterior cardinal angle and along anterior dorsal slope to form dentitions at opposite extremities of hingeline; anterior overlap greater than posterior; dorsal view of hingeline straight and depressed in posterior half; posterior end broadly rounded; ventral margin slightly concave; anterior margin broadly rounded, edges of valves being formed into slightly thickened lips; left valve slopes gently from mid-dorsal to dorsal-anterior, where height is five-eighth the greatest height; greatest height is posterior half; in right valve an obtuse cardinal angle is formed between the slightly convex dorsal margin and straight anterior-dorsal margin; dorsal aspect wedgeshaped; greatest thickness about one-third the length from posterior; length, 0.95 mm.; height, 0.55 mm.; width, 0.32 mm.

Holotype, Columbia University Paleo., Coll., No. 27519.

***Ellipsella gilei* Coryell and Rogatz n. sp.**

Plate XXXV, Figs. 9, 10.

Description: Small, smooth, elongated, sub-elliptical carapace; very slightly inequivalved; hingeline undulating with right valve almost imperceptibly overlapping left valve except at opposite ends of hingement where overlap is great and forms dentitions at the posterior cardinal angle and anterior dorsal slope, the latter producing greater obliquity of anterior cardinal angle; dorsal margin very slightly convex; posterior margin broadly rounded; posterior ventral margin truncated; ventral margin convex; anterior border very broadly rounded; right valve extending beyond left only very slightly at anterior and posterior margins; anterior edges of valves thickened very slightly to form lip-like structure; dorsal aspect an elongated ellipse.

Holotype, Columbia University Paleo., Coll., No. 27518.

This species differs from *Ellipsella obliqua* in that the anterior dorsal margin of left valve is not truncated. Also, the hinge-line is undulating and greatest width is median.

This species is named for Richard E. Gile.

COLUMBIA UNIVERSITY, NEW YORK, N. Y.

PLATE XXXIV.

(All figures x45)

Figures

- 1-3 *Knoxina lecta* Coryell and Rogatz n. g., n. sp. (Fig. 1, left valve; fig. 2, right valve; fig. 3, dorsal view.)
- 4-6 *Knoxina elliptica* Coryell and Rogatz n. sp. (Fig. 4, left valve; fig. 5, right valve; fig. 6, dorsal view.)
- 7-9 *Knoxina incurvata* Coryell and Rogatz n. sp. (Fig. 7, left valve; fig. 8, right valve; fig. 9, dorsal view.)
- 10-12 *Knoxina indistincta* Coryell and Rogatz n. sp. (Fig. 10, left valve; fig. 11, right valve; fig. 12, dorsal view.)

PLATE XXXIV.

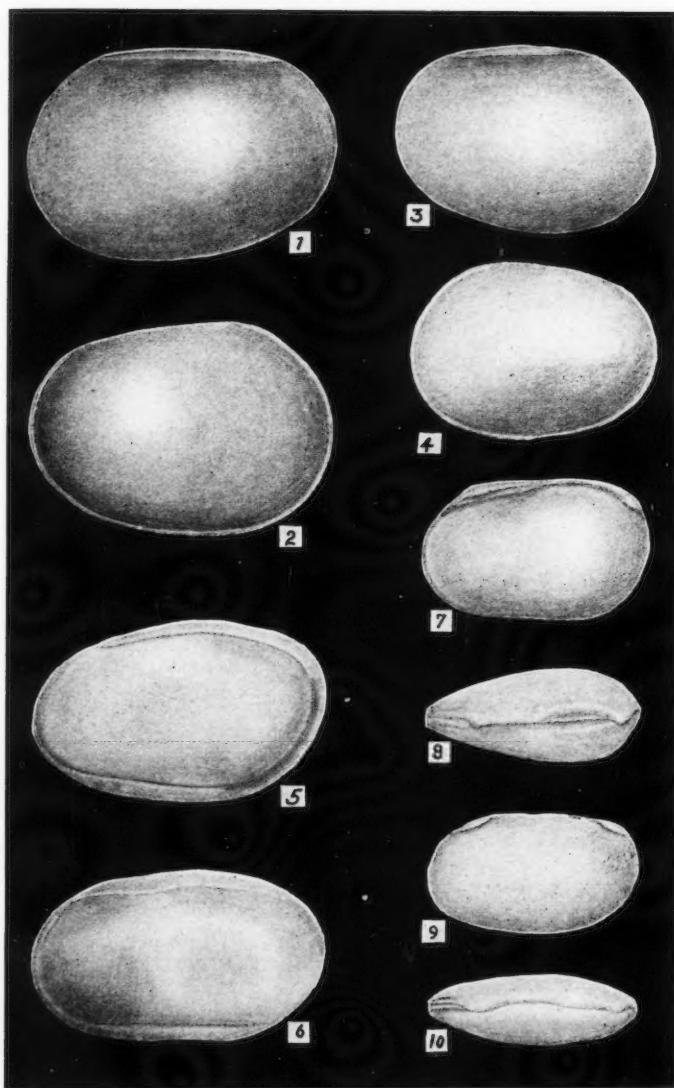


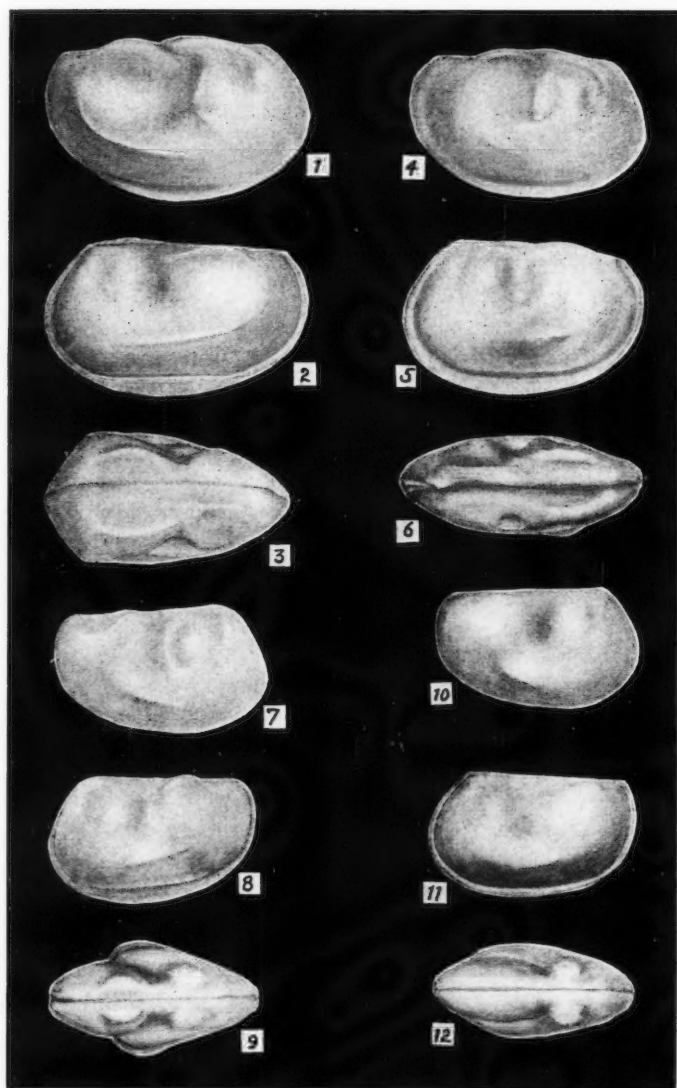
PLATE XXXV.

(All figures x45)

Figures

- 1-2. *Paraparchites oviformis* Coryell and Rogatz n. sp. (Fig. 1, right valve; fig. 2, left valve.)
- 3-4. *Antiparaparchites reversus* Coryell and Rogatz n. g., n. sp. (Fig. 3, left valve; fig. 4, right valve.)
5. *Cavellina arcuta* Coryell and Rogatz n. sp. (Left valve.)
6. *Cytherella molaris* Coryell and Rogatz n. sp. (Left valve.)
- 7-8. *Ellipsella obliqua* Coryell and Rogatz n. g., n. sp. (Fig. 7, left valve; fig. 8, right valve.)
- 9-10. *Ellipsella gilei* Coryell and Rogatz n. sp. (Fig. 9, left valve; fig. 10, right valve.)

PLATE XXXV.



NEW UPPER CARBONIFEROUS OSTRACODA FROM OKLAHOMA AND KANSAS

R. W. HARRIS AND CECIL G. LALICKER

The writers present the following new genera and species discovered while working out the micro-fauna of the upper Carboniferous (Pennsylvanian and so-called Permian) of Oklahoma and Kansas. The majority of microscopic forms range from lower or middle Pennsylvanian through the Herington limestone. The range of these new forms undoubtedly will be extended through further research.

Holotypes and figured specimens are deposited in the University of Oklahoma Paleontological Collections.

Phylum ARTHROPODA

Order OSTRACODA Latreille

Family APARCHITIDAE Ulrich and Dassler

Genus PARAPARCHITES Ulrich and Bassler, 1906

Paraparchites humerosus Ulrich and Bassler var. **kansasensis** Harris and Lalicker n. var.

Plate XXXVI, Figs. 1a, b.

This variety differs from the type in its much smaller size, uneven convexity, greater posterior height, and in the loci of greatest thickness being distinctly above and in front of center in antero-dorsal quarter. It differs from *P. humerosus* var. *texana* Delo, in the unequal curvature of the antero-dorsal and antero-ventral margins. It differs from *P. bimatus* Delo, in the absence of the prominent dorsal inflation of the left valve and conspicuous elongate ventral swelling.

Length, 0.75 mm.; height, 0.59 mm.

Holotype, No. 555 from Wreford limestone, four miles northeast of Burden, Cowley county, Kansas.

Family BEYRICHIIDAE Jones, restricted Ulrich and Bassler

Genus **Albanella** Harris and Lalicker n. gen.

Carapace small, biconvex, sub-elliptical, with slight backward swing; elongate, straight, channelled hinge line;; surface smooth, the single ornamentation being a large protruding, nearly central, node.

Genotype, *Albanella gouldi* Harris and Lalicker n. sp.

Range: Upper Carboniferous.

Albanella gouldi Harris and Lalicker n. sp.

Plate XXXVI, Figs. 2a, b.

Carapace small, sub-elliptical, with faint backward swing; elongate, straight, channelled hinge line; carapace gently biconvex, anteriorly rather flatly so, especially at margins, protruding central node located slightly above median line, surface otherwise smooth.

Length, 0.67 mm.; height, 0.37 mm.

Holotype, No. 556 from Wreford limestone, five miles south of Dexter, Cowley county, Kansas.

Remarks: Two specimens in the authors' collections establish this species. Its small size, protruding central node, straight to slightly swayed hinge line, and rather uniformly convex outline are its distinguishing characters.

Super family BEYRICHIACEA

Family PRIMITIIDAE Ulrich and Bassler

Genus **Coryella** Harris and Lalicker n. gen.

Carapace small, hollinelloid in outline, with pronounced backward swing; elongate, median sulcus extending to center, with prominent, anterior spine and low posterior node, slight incision slightly behind post-dorsal angle, carapace inflated by a posterior ventral ridge which is terminated anteriorly by a blunt spine, surface otherwise smooth.

Genotype, *Coryella stovalli* Harris and Lalicker n. sp.

Range, Upper Carboniferous.

Remarks: This genus is not far removed from *Jonesina* Ulrich and Bassler. It differs in the exaggerated antero-dorsal spine and in the ventral ridge-like inflation with its anterior spine.

***Coryella stovalli* Harris and Lalicker n. sp.**

Plate XXXVI, Figs. 3a, b, c.

Carapace small, sub-quadrate in outline with straight hinge and pronounced backward swing; posterior extremity evenly rounded, carapace inflated ventrally in a ridge-like swelling that parallels the free margin posteriorly and ventrally and terminates in a blunt spine in the anterior quarter, slightly post-central sulcus extends downward to the median line, a prominent, dorsal, forward-projecting spine located in front of sulcus on level with hinge line, lower swelling behind, somewhat farther removed from hinge line, a short V-like incision located in front of the post-dorsal angle.

Length, 0.59 mm.; height, 0.34 mm.

Holotype, No. 557 from Garrison shale, Matfield Green, Chase county, Kansas.

Remarks: This species is distinguished by its hollineloid form, two forward projecting anterior spines, and central sulcus.

***Monoceratina lewisi* Harris and Lalicker n. sp.**

Plate XXXVI, Figs. 6a, b.

Carapace elongate, tumid, maximum height median; hinge line straight, slightly upturned at anterior end; anterior extremity acutely pointed, posterior extremity rounded, distinctly protruding backward, prominent forward-projecting spine located antero-centrally on ventral margin, inflated node slightly behind center and below the median line, minute tubercle located at the post-dorsal angle and set off anteriorly by a slight incision, shallow sulcus posterior to center, free margin depressed, flange-like posteriorly and especially anteriorly; surface punctate.

Length, 0.67 mm.; height, 0.32 mm.

Holotype, No. 558 from Fort Riley limestone, eight miles southeast of Towanda, Butler county, Kansas.

Remarks: This species is characterized by the elongate outline, protruding ventral spine, dorsal and posterior nodes, and fine punctations.

***Jonesina alta* Harris and Lalicker n. sp.**

Plate XXXVI, Fig. 4.

Carapace sub-hemispherical in outline with slight backward swing, valves highly inflated with point of greatest thickness immediately anterior to the lower end of the sulcus; hinge line nearly straight, pinched above sulcus, equaling in length about four-fifths the longest diameter of the carapace; cardinal extremities obtusely angular, the posterior angle the greater, dorsal margin extended above hinge line by an anterior lobe, posterior end well rounded, a deep, post-central, forward-curving sulcus marks the dorsal third of the carapace, marginal flange narrow and well developed around free margins.

Length, 0.89 mm.; height, 0.61 mm.

Holotype, No. 559 from Cottonwood limestone four miles southeast of Grand Summit, Cowley county, Kansas.

Remarks: This species is characterized by the highly inflated valve, great height with respect to length, curving sulcus, and extended swelling of the anterior lobe near and above the dorsal margin. It differs from *J. gregaria* (Ulrich and Bassler) in being shorter, higher, and possessing a short curving sulcus.

***Jonesina uncialis* Harris and Lalicker n. sp.**

Plate XXXVI, Fig. 5.

Carapace sub-hemispherical in outline, swinging backward very faintly, valve convex with point of greatest thickness in central horseshoe lobe; hinge line straight, almost equaling the maximum height of shell; the two ends sub-equal, poste-

rior slope steep, rounding through the sharply curved ventral margin; a deep, narrow, straight, backwardly-inclined sulcus is located in the center of the valve, carapace pitched up centrally into a nodose horseshoe-like lobe about the median sulcus, anterior end of lobe terminated by an elongate, pronounced node slightly below the hinge line, posterior end of lobe terminated by a low node just above and behind lower end of sulcus, median extent of horseshoe pinched about lower end of sulcus, carapace slightly incised anteriorly at base of most prominent node; surface smooth.

Length, 0.67 mm.; height, 0.50 mm.

Holotype, No. 560 from Garrison shale, three miles east of Elmdale, Chase county, Kansas.

Remarks: This species is characterized by the hemispherical outline, elongate sulcus, and the horseshoe-shaped central ridge. This species differs from *J. bollia-formis* Ulrich and Bassler, in the hemispherical outline, deep, narrow sulcus, and absence of rounded, distinct nodes.

***Jonesina papillosa* Harris and Lalicker n. sp.**

Plate XXXVII, Fig. 1.

Carapace sub-hemispherical in outline with faint backward swing, equally convex, with greatest convexity centrally and below sulcus; anterior cardinal angle approximately ninety degrees; narrow forward-curving sulcus extends from hinge line to a point slightly above center, top of sulcus slightly anterior to center, at post-dorsal angle an asymmetrical V-like incision; surface granular to papillose.

Length, 0.82 mm.; height, 0.59 mm.

Holotype, No. 561 from Foraker limestone, three miles southeast of Americus, Lyon county, Kansas.

Remarks: This species differs from *J. texana* Harlton by being more papillose and possessing a more semi-circular outline.

***Jonesina papillosa* var. *inflata* Harris and Lalicker n. var.**

Plate XXXVII, Fig. 3.

The single form of this variety in the writers' collections is characterized by its larger size, and highly inflated nodose anterior half that projects noticeably above the hinge line.

Length, 0.84 mm.; height, 0.59 mm.

Holotype, No. 562 from Foraker limestone, 1 1-4 miles northeast of Elmdale, Chase county, Kansas.

***Jonesina primitioides* Harris and Lalicker n. sp.**

Plate XXXVII, Fig. 2.

Carapace small, sub-elliptical in outline, greatest thickness central; hinge line straight, equaling about three-fourths maximum length; extremities evenly curved; a straight, very shallow central sulcus extends downward to a point just above center of carapace, surface smooth, equally convex.

Length, 0.45 mm.; height, 0.29 mm.

Holotype, No. 563 from the Neva limestone, one-half mile north of Reece, Greenwood county, Kansas.

Remarks: This species is characterized by its small size, equal convexity, and simple primitioid sulcus. The latter is often so faint that it appears only as a slightly darkened vertical mark.

Family KLOEDENELLIDAE Ulrich and Bassler

Genus ***Sansabelloides*** Harris and Lalicker n. gen.

Carapace elongate, sub-rectangular in outline, with high anterior rose produced by antero-dorsal and -ventral oblique truncation, evenly convex; left valve slightly overlapping entire margin of right valve; hinge line slightly arched; shallow central pit located just above median line, surface smooth, granulose, or slightly wrinkled, especially at extremities.

Genotype: *Jonesina texana* Warthin (not Harlton)

Remarks: This cytherelloid genus differs particularly from *Sansabella* Roundy, in its arched hinge line.

Sansabelloides texana (Warthin) Harris and Lalicker

Plate XXXVII, Figs. 4a, b.

Jonesina texana Warthin, (not Harlton) 1930, Micropaleontology of the Wetumka, Wewoka, and Holdenville Formations, Okla. Geol. Surv. Bull. 53, p. 60, pl. IV, fig. 10.

Carapace elongate, sub-quadrate in outline; anterior end thick, blunt, and obliquely truncated ventrally to produce an angular nose near the hinge line, in dorsal view sides sub-parallel, converging posteriorly, posterior end thin, equally rounding, posterior extremity of valves sub-carinate; overlap of left valve entire, most prominent dorsally slightly behind the center and ventrally at the center, distinct at both ends; the circular sansabelloid pit located centrally just above the median line, surface otherwise smooth.

Length, 0.91 mm.; height, 0.46 mm.

Holotype, No. 564 from Francis formation in brick pit south of Ada, Okla.

R e m a r k s : This upper Pennsylvanian species is characterized by its subcytherelloid outline with single median pit.

Sansabelloides edmistoni Harris and Lalicker n. sp.

Plate XXXVII, Fig. 5.

Carapace small, elongate; slightly arched dorsal margin, gently and obliquely truncated anteriorly to produce an indistinct angle just in front of the center, ventral margin straight, anterior nose high due to slight antero-ventral oblique truncation, posterior end evenly rounded; overlap of left valve entire, regular, but faint, straight along ventral edge; surface evenly convex, smooth, shallow central pit located just above median line, a second very faint depression is located above and posterior to the larger pit, median area often granular.

Length, 0.53 mm.; height, 0.23 mm.

Holotype, No. 565 from Garrison shale, one-half mile north of Dexter, Cowley county, Kansas.

Remarks: This species differs from *S. texana* (Warthin) in its much smaller size, slightly angled hinge line, and less evident overlap.

Family KIRKBYIDAE Ulrich and Bassler

Genus ULRICHIA Jones, 1890

Ulrichia minuta Harris and Lalicker n. sp.

Plate XXXVII, Fig. 6.

Carapace very small (length, 0.56 mm.), sub-rectangular, with very faint backward swing, maximum length along center of carapace; cardinal angles obtusely indistinct, post-cardinal angles obtusely indistinct, post-cardinal angle the more angular; hinge straight, channeled along entire length; anterior and posterior nodes pointed in their dorsal extensions above hinge line, both extend as prominent, vertical ridges nearly to inner flange and are separated by a distinctly concave surface, the anterior node is slightly the more prominent, small sub-central Kirkbyan pit, surface coarsely reticulate, seven or eight reticulations in entire height.

Length, 0.56 mm.; height, 0.27 mm.

Holotype, No. 566 from Fort Riley limestone, one mile southwest of New Salem, Cowley county, Kansas.

Remarks: This species is characterized by its small size, pointed vertical nodes, coarse reticulations, and channeled hinge line.

Family GLYPTOPLEURIDAE Girty

Genus GLYPTOPLEURA Girty, 1910

Glyptopleura triserta Harris and Lalicker n. sp.

Plate XXXVII, Fig. 8.

Carapace small (length, 0.88 mm.), slender, sub-quadrate, slightly inflated, pitched up and thickest in anterior nose; dorsal margin straight, antero-cardinal angle rounding into the evenly rounded anterior extremity, post-cardinal angle distinct (115 degrees), post-dorsal slope straight to a point

slightly above center, thence rounding evenly into the straight but sloping ventral margin, posterior end most produced below center, higher than anterior end; valves sub-equal, overlap of the left indistinct; hinge line channeled, slightly arched; valves ornamented with four longitudinal and parallel coarse ribs sloping gently backward and downward, the lowest rib terminating posteriorly at a point forward to the other ribs, a very short parallel rib occupies the post-dorsal area, three very short ribs are inserted anteriorly between and above the three upper main costae, the faint central pit is located just below and slightly behind the center of the upper coarse rib.

Length, 0.88 mm.; height, 0.48 mm.

Holotype, No. 567 from the Wreford limestone, five miles south of Dexter, Cowley county, Kansas.

Remarks: This species is characterized by the short post-dorsal rib, the three short anterior ribs among the upper three coarse ribs, depressed hinge line in its anterior portion, and thickened anterior end.

Family BAIRDIIDAE Ulrich and Bassler

Genus BAIRDIA McCoy, 1844

Bairdia bulleta Harris and Lalicker n. sp.

Plate XXXVII, Fig. 7.

Carapace small, elongate, sub-triangular in side view with greatest height at center of posterior half, in dorsal view equally biconvex; dorsal line rather steeply sloping posteriorly from point of greatest height, while anterior slope is more gentle, noses rounded, the anterior the lower and sharper, ventral margin practically straight; overlap of left valve faint, most prominent in center of dorsal margin, ventral line of overlap straight; surface smooth, equally convex.

Length, 0.62 mm.; height, 0.33 mm.

Holotype, No. 568 from Lueder limestone, two miles southeast of Seymour, Baylor county, Texas, on north bank of Salt Fork of Brazos River.

Remarks: This small species is characterized by the sub-triangular shape, faint overlap, and greatest height in posterior half.

Bairdia maxeyi Harris and Lalicker n. sp.

Plate XXXVII, Fig. 9.

Shell large, elongate, length about twice the height, in dorsal view rather thin; dorsal margin curved, highest well behind the center, dropping steeply to the acuminate posterior extremity, anterior extremity about three-fourths the height of the shell, post-dorsal slope straight, post-ventral extremity rounded, very slightly upturned, ventral edge slightly concave centrally, curving upward regularly and sub-equally at the ends; valves unequal, the left being much the larger, overlap is conspicuous and even along the dorsal margin, ventral overlap is confined to medium concave area; surface smooth, convex, thickest centrally.

Length, 1.15 mm.; height, 0.50 mm.

Holotype, No. 569 from the Crouse limestone member of the Garrison shale, NW NW Sec. 36; T33S; R6E, Cowley county, Kansas.

Remarks: *B. pecosensis* Delo, its nearest likeness, is much thicker and its surface in finely pitted.

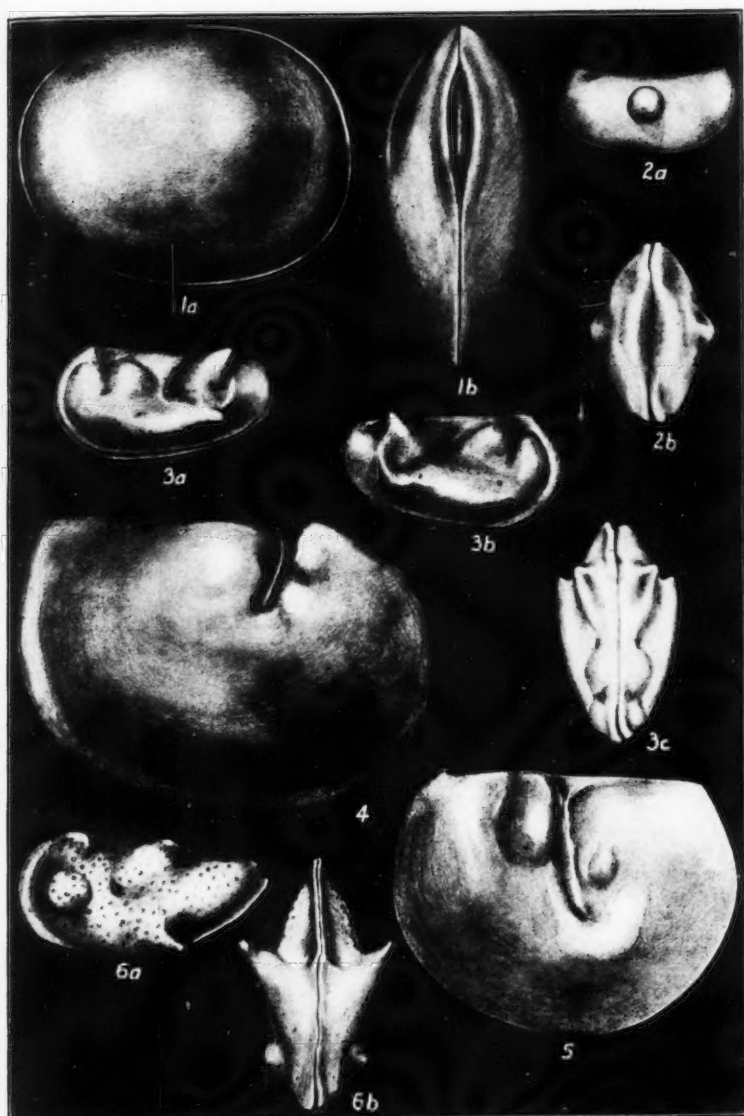
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Figures drawn by Mrs. Cecil G. Lalicker.

PLATE XXXVI.



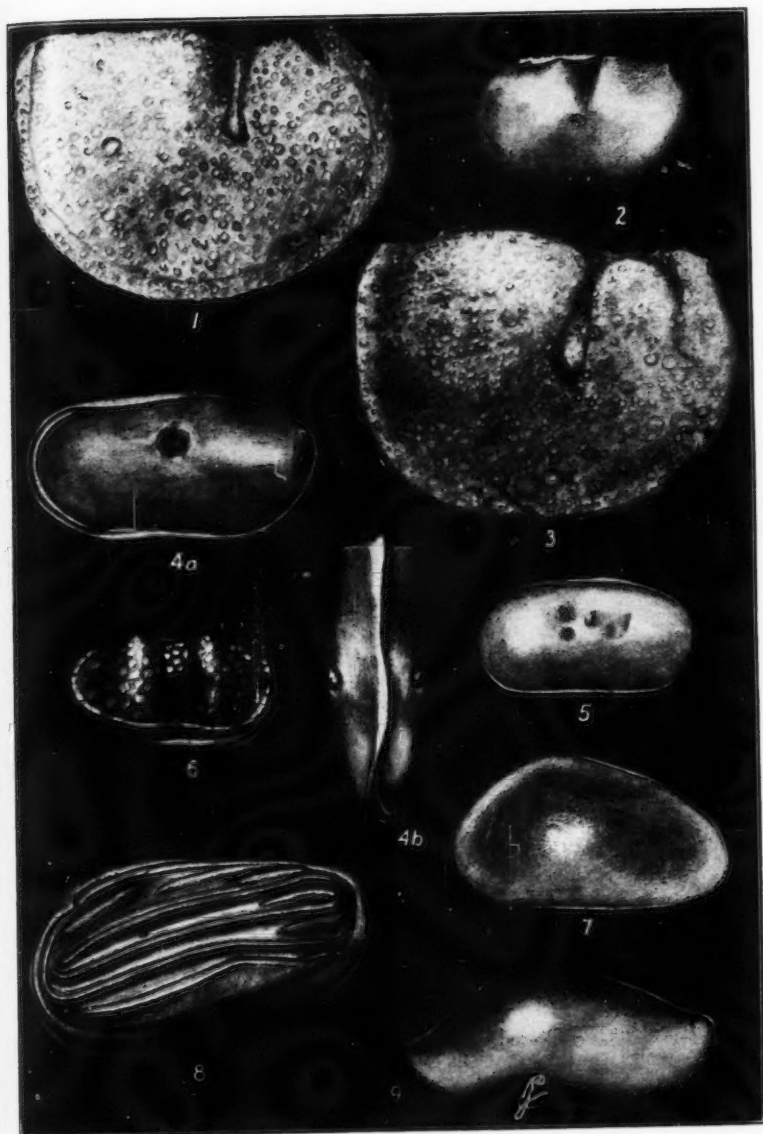
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Figures drawn by Mrs. Cecil G. Lalicker.

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BOOK REVIEWS

THE INVERTEBRATA, by L. A. Borradaile and F. A. Potts, with chapters by L. E. S. Eastman and J. T. Saunders. Cambridge: The University Press; New York: The Macmillan Company, 1932. xiv+645 pp., \$5.50.

For some years, biologists and paleontologists desiring an English summary of the taxonomy and anatomy of the major invertebrate groups have found themselves in difficulty. Parker and Haswell's familiar *Textbook of Zoology* (Macmillan) adheres closely to the "type method," and so goes into greater detail than is necessary at the cost of taxonomic reduction. Lankester's *Treatise* (Black), on the other hand, is detailed but not adequately modern, and is uneven from volume to volume. Bather's treatise on Echinoderma is a model for the combination of living and extinct phases of the animal world, but not all of the volumes approach its excellence. And as I have found, they are apt to be out of reach of small college libraries, with whose resources many students must be content.

These considerations give special interest to the appearance of this textbook by Borradaile and his collaborators. Though designed for students who have completed a year's study in zoology, it is so detailed as to suggest a reference volume rather than a text, and as such will be added to many libraries. By including brief descriptions of fossil groups, it approaches the goal set by Bather, and aids the paleontologist who wishes to refer his materials to their place in the general scheme of taxonomy, and who is not content with the time-worn classification of Zittel and Eastman.

The extent to which Borradaile and his co-workers depart from some familiar texts, and give attention to both fossil and recent organisms, may be seen from a few examples. The Brachiopoda and Polyzoa (Bryozoa) are grouped as Molluscoidea by Zittel-Eastman; here they appear as distinct phyla. The Vermes of paleontology (Zittel-Eastman, Berry) are divided, and their distinctions so clearly shown, that there no longer can be excuse for retaining the ancient "phylum" on the ground that differences are purely technical. The Trilobita are raised from subclass (Zittel-Eastman) to subphylum, with greater emphasis on their development than is customary in books on zoology. There is a summary of extinct classes of Echinoderma (Amphoroidea, Carpoidea, Thecoidea, Cystoidea and Blastoidea), and a discussion of extinct as well as modern cephalopods. Illustrations of Crania in the act of feeding and contracted position of *Lingula* will be of value to paleontologists. The inclusion of a chapter on the Protochordata is justified by the fact that the book deals with non-vertebrates, not non-chordates—and by the

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close relationship between the lowest chordates and other phyla. There is no suggestion, however, that the vertebrates should be dignified as a phylum, as a few paleontologists and zoologists have decided.

This does not imply that Borradaile and Potts have produced many innovations in classification. Quite the reverse is true: the reader who is familiar with modern zoology will not find himself distracted by mere novelties. My point is that conclusions accepted in modern zoology may still be relatively novel in the classification of fossils. So long as Vermes stand in paleontologic texts, and Porifera are placed in the Coelenterata (Borradaile ranks them as a subkingdom, Parazoa) there is no need for such a book as this, on the desks of those who study fossil invertebrates. One hardly can doubt that the same features of modernity, inclusiveness and compactness, which give it this special value, also will insure it acceptance by zoologists to whom a ready reference manual is essential, or a thorough course in invertebrate taxonomy and anatomy still something to be desired.—CARROLL LANE FENTON.

EARTH HISTORY, by Luther Snider. New York: The Century Company. 1932. xvii + 683 pp. \$4.50.

This volume initiates the *Century Earth Science Series*, under the editorship of Dr. Kirtley F. Mather. Earlier series and special textbooks in geology and geography have been designed, in the main, to prepare professional workers in those fields—and as a result, have alienated the majority of students while leaving them almost unaware of the essential contributions that earth science has made to human thought and material progress. The sponsors of the Century series aim to present those facts and principles which are essential to a modern education, and which should be comprehended by every college graduate, whatever his future occupation may be. They also appeal to those lay readers for whom I recently recommended Scott's *Introduction to Geology*, being unaware that an even more suitable work already was on the press.

In keeping with its relatively novel viewpoint, *Earth History* displays an organization and a style unlike those of the traditional textbook. In place of the familiar division into physical and historical geology, it contains four principal sections, all essentially historical in plan. Section I, eighty-three pages in length, summarizes the materials and processes of the earth, the keys to its history, geologic cycles, and the nature of continental basins, high borderlands, and marine troughs. Section II presents the history of continents—the only parts of the earth, by the way, of whose changes we can be at all certain. Here the order adopted is somewhat confusing, at least to those who view earth history as a series of continuous processes: even though events of the Pre-Cambrian are much less obvious than those of later eras, it hardly seems that they should be deferred to a chapter after that on Pleistocene glaciation. The one apparent advantage of this lies in their

convenient approach to theories of earth origin, of which the one advanced by Chamberlin and Moulton is selected for special favor. Others, however, are presented fairly, without hint of those rival claims for credit which at least one of them has provoked. The six major theories of mountain building also are briefly presented, as are those seeking to account for climatic change. No special claims are made for any, and both fields are mentioned as in need of much careful study.

Part III discusses the history of organisms, from the Proterozoic to the present. There is a compact classification of plants and animals, the former employing the phylum Thallophyta, the latter, the obsolete one of Vermes. This is the more surprising because modern zoological procedure is followed in raising the Brachiopoda to a phylum and the Trilobita to a class. Why this discrimination against the humble Annelida, which after all are important as fossils? Discussion of the several groups accepts the proportions laid down by Lamarck: invertebrate phyla receive fifty-four pages and the vertebrates one hundred fifty-two. Here, however, the discrepancy is partly justified by the interest which vertebrates hold for mankind and the extent to which they have been used in formulating principles that should enter into general thought. The chapter on life cycles (by which is meant faunal and floral cycles, not those of individual organisms) is a useful summary, free from the neo-Lamarckian dogmatism that dominates much writing on this subject.

Section IV, "Man and Earth History," seeks to link daily life with geologic knowledge. The nature and importance of mineral deposits are shown; spectacular events such as floods, earthquakes and volcanic eruptions are taken from the realm of newspaper headlines and given their proper place in earth history. The significance of scenery receives a chapter, as does a generalized description of present-day continents, while the book is closed by a provocative summary entitled briefly, "Present and Future."

A few adverse criticisms may be made—based, one admits, upon personal preference. The chapter on the development of earth science seems out of place between the one on scenery and that describing continents; it would have served better as an appendix. The reproduction of Schmidt's antique restorations (as of *Mosasaurus*, Fig. 168) is out of keeping with the generally high standard of illustrations, and the same may be said of a few apparently original drawings. In the main, however, the three hundred thirty-three figures are well chosen and excellently printed, and avoid those pictures that already have become too familiar in textbooks and popular volumes. Thus they preserve the tone set by the plan of the volume, and help make *Earth History* a significant achievement in the non-technical literature of geology and paleontology. It is a book that should be welcomed in the growing number of colleges which stress the cultural value of earth science, as well as by the inquiring general reader.—CARROLL LANE FENTON.

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